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***MR. BOADI EBENEZER KWAME- OLD LASHIBI TWMA JHS, TEMA (0557413011)***

***MR. STANLEY SOWAH- OLD LASHIBI TWMA JHS, TEMA***

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## BASIC7

## STRAND 1: DIVERSITY OF MATTER

### Sub-strand 1: Materials

### B7.1.1.1.1 Classify materials into liquids, solids and gas

**Materials** are substances that are used to make objects or products. They can be natural, such as wood, stone, or metals or they can be synthetic, such as plastics or ceramics. Materials have different properties, such as strength, flexibility, conductivity, and durability, which make them suitable for specific applications. ***All materials have mass and volume***

Materials play a crucial role in various industries, including construction, manufacturing, electronics, and transportation. Examples of materials*: Wood, plastic, glass, stone, paper Water, milk, juice, oil, vinegar, soda Oxygen, nitrogen, carbon dioxide, helium, hydrogen, rubber, ceramic, cotton, wool, concrete, brick, diamond, graphite, sand, salt, sugar, chalk, clay, iron, alcohol, honey, syrup, ink, detergent, bleach, coffee, tea, soup, shampoo, conditioner, lotion, perfume, air, steam, smoke, fog, methane, propane, natural gas, ozone, ammonia, etc.*

**Classification of materials Into Solids, Liquids and Liquids.**

The above listed materials have been classified or grouped into solids, liquids and gases

| SOLID | LIQUID | GAS |
|---|---|---|
| Wood, plastic, glass, stone, paper, rubber, ceramic, cotton, wool, concrete, brick, diamond, graphite, sand, chalk, clay, iron | Water, milk, juice, oil, vinegar, soda, alcohol, honey, syrup, coffee, tea, soup, shampoo, conditioner, lotion, perfume | Oxygen, nitrogen, carbon dioxide, helium, hydrogen, air, steam, smoke, fog, methane, propane, natural gas, ozone, ammonia |

**Arrangement of Particles in Solids, Liquids and Gases.**

***SOLID***

The particles in solid are closely packed together and arranged in a regular pattern. They vibrate in place but do not move around freely. The strong forces of attraction between the particles hold them in a fixed position, giving solids a definite shape and volume. **Solid cannot flow because its particles are tightly packed and have a fixed position. The intermolecular forces between the particles are strong, preventing them from easily moving past each other**. This is why solids maintain their shape and do not flow like liquids or gases.

***LIQUID***

In a liquid, the particles are still close together, but they have more freedom to move compared to particles in a solid. The particles in a liquid are not as tightly packed as in a solid, and they have more energy, allowing them to move past each other. However, they are still attracted to each other, which is why liquids have a definite volume but not a definite shape**. Liquids flow because their particles have enough energy to move past each other. The particles in a liquid are not as tightly packed as in a solid, and they have more freedom to move. This allows liquids to take the shape of their container and flow from one place to another. The ability of liquids to flow is due to the weaker intermolecular forces between the particles compared to solids.**

***GAS***

In a gas, the particles are much more spread out compared to solids and liquids. The particles in a gas have a lot of energy and move rapidly in all directions. They are not held together by strong forces like in solids or liquids, which allows them to move freely and independently. This is why gases do not have a definite shape or volume and can expand to fill the space available to them. **Gas flows because its particles have high kinetic energy and are not bound together in a fixed arrangement. This allows them to move freely and fill the space available to them. The**

**movement of gas particles is influenced by factors such as temperature, pressure, and concentration gradients.**

## Characteristics of solid

- Strong intermolecular forces.
- Particles vibrate in place.
- Low kinetic energy (KE)
- Definite shape.
- Definite volume.
- Incompressible.
- High density (as compared to same substance as a liquid or gas)
- Low rate of diffusion (millions of times slower than in liquids)

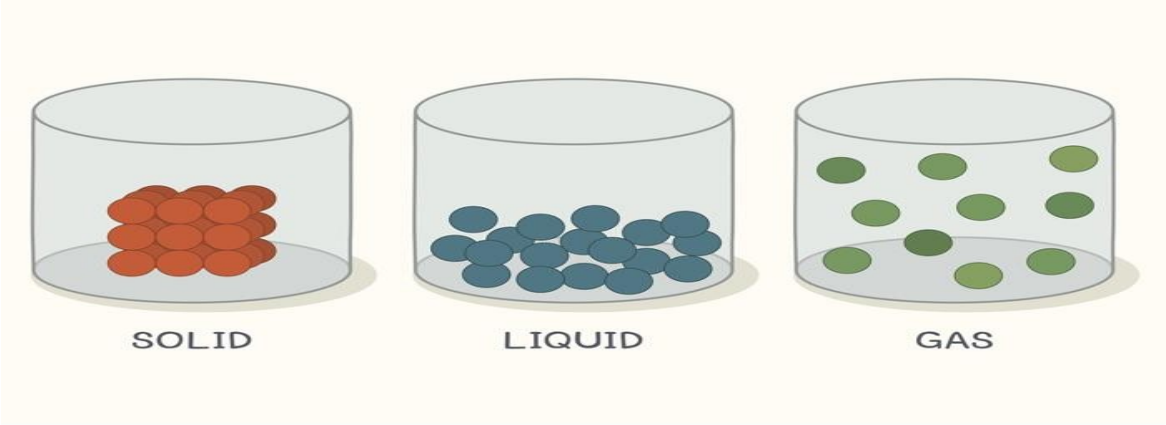
## Characteristics of liquid

- Liquid has a fixed volume but no fixed shape.
- Liquids can be compressed. Large pressure is required to compress them.
- Liquids have lesser densities than solids.
- The intermolecular forces of attraction are weaker than solids.
- They have considerable space between the particles.

## Characteristics of gas

- Gases have no definite shape. They take the shape of containing vessel.
- Gases have no definite volume.
- They have a property to fill the entire space available to them.
- Gases can be compressed.
- Gases have no free surface

## DIAGRAM TO SHOW THE PARTICLES ARRANGEMENT IN SOLID, LIQUID AND GAS




**Here are the differences between liquids, solids, and gases:**

| **Characteristics of the particles** | **Solid** | **Liquid** | **Gas** |
|---|---|---|---|
| 1. Particle arrangement | Particles are closely packed together and arranged in a regular pattern. They have a fixed shape and volume. | Particles are also close together, but they are not arranged in a regular pattern. Liquids take the shape of their container but have a fixed volume. | Particles are far apart and move freely. Gases have no fixed shape or volume and expand to fill the entire container. |
| 2. Particle motion | Particles vibrate in fixed positions but do not move around freely. | Particles are in constant motion, sliding past each other | Particles move rapidly and randomly in all directions. |

| | | | |
|---|---|---|---|
| 3. Intermolecular forces: | The intermolecular forces between particles are strong, holding them closely together | The intermolecular forces are weaker, allowing particles to move more freely | The intermolecular forces are very weak, and particles are far apart from each other. |
| 4. Compressibility | Are generally not compressible because the particles are tightly packed. | Are also not easily compressible, but they can be compressed slightly under high pressure. | Are highly compressible because the particles are far apart. |
| 5. Density | Are usually denser than liquids and gases because the particles are closely packed together | Are denser than gases because the particles are closer together in liquids compared to gases. | Gases have low density because their particles are spread out and have a lot of empty space between them |

**B7.1.1.1.2 Discuss the importance of liquids in the life of human**

Liquids play a crucial role in the life of humans in several ways. Firstly, our bodies are composed mostly of water, which is a liquid. Water is essential for various bodily functions, including hydration, digestion, and temperature regulation.

**1. Hydration**: Liquids, especially water, are essential for maintaining proper hydration in the body. They help regulate body temperature, transport nutrients, and remove waste products.

**2. Digestion:** Liquids play a crucial role in the digestion process. They help break down food, facilitate the absorption of nutrients, and aid in the smooth movement of food through the digestive system.

**3. Lubrication:** Liquids, such as saliva and synovial fluid, provide lubrication to various parts of the body. This includes lubricating the joints, allowing for smooth movement, and lubricating the eyes, preventing dryness and irritation.

**4. Transportation**: Liquids, such as blood, transport oxygen, nutrients, hormones, and waste products throughout the body. They ensure that essential substances reach the cells and that waste products are efficiently removed.

**5. Cleaning and hygiene:** Liquids, such as water and cleaning solutions, are used for personal hygiene, cleaning surfaces, and maintaining cleanliness in various settings. They help remove dirt, bacteria, and other contaminants, promoting health and preventing the spread of diseases.

**Discuss the importance of specific solids to life**

There are several examples of solid materials from the environment that are important for survival of human beings. Examples include iron bars, tables, chair, table salt, sugar, ice block, frozen carbon dioxide (dry ice), glass, rock, metallic objects, wood, tree, land, Clay, empty bottles, palms nuts, palm fronds, cement block etc.

**Importance of Dry ice.**

1. It is used in the food and agriculture sector to keep food from spoiling during transportation.
2. They are used to preserve human body until the time for the funeral.
3. Dry ice is used in broken/damaged freezers and refrigerators to keep its contents cold.
4. Dry ice is used to remove oxygen from flammable tanks when placed inside. This prevents flammable gases from catching spark and exploding.
5. Dry ice allows asphalt to stay at required temperatures during transportation from manufacturing plant to job site.

## Importance Of table salt

1. It flavours food
2. It is used as a binder and stabilizer.
3. It is also a food preservative, as bacteria can't thrive in the presence of a high amount of salt.
4. The human body requires a small amount of sodium to conduct nerve impulses, contract and relax muscles, and maintain the proper balance of water and minerals.

**Solids in the environment that support the survival of humans and other life forms, along with examples:**

**1. Soil:** Soil provides a medium for plant growth, supporting the production of food for humans and serving as a habitat for countless organisms. Example: loam soil, which is a mixture of sand, silt, and clay.

**2. Rocks**: Rocks provide habitats for plants and animals, contribute to soil formation, and offer protection from erosion and extreme weather. Example: granite, a common type of rock found in the Earth's crust.

**3. Minerals:** Various minerals are essential for human and animal nutrition, industrial processes, and the functioning of ecosystems. Example: iron, which is crucial for oxygen transport in the blood.

**4. Salt:** Salt crystals play a role in maintaining the balance of fluids in our bodies and are essential for various physiological functions. Example: sodium chloride (table salt).

**5. Crystals:** Crystals play diverse roles in nature and technology, from forming the basis of many minerals to being used in electronic devices. Example: quartz crystal, commonly used in electronics and timekeeping.

**6. Sand:** Sand provides nesting sites for certain animals, supports plant growth in coastal areas, and plays a role in filtering water. Example: beach sand composed of finely ground minerals and organic materials.

**7. Clay:** Clay has been used by humans for thousands of years for pottery, construction, and as a soil amendment. It also provides habitat for burrowing animals. Example: kaolin clay, commonly used in ceramics and skincare products.

**Preserving useful solid materials in the environment is crucial for sustaining life for several reasons:**

**1. Ecosystem Health:** Many solid materials, such as soil and rocks, are essential for maintaining healthy ecosystems. Soil supports plant growth, which forms the basis of food chains and provides habitats for a wide range of organisms. Rocks and other geological formations contribute to habitat diversity and ecological balance. Preserving these materials ensures the stability and health of natural environments.

**2. Resource Availability:** Useful solid materials, including minerals and natural resources, are vital for human survival and economic development. Preserving these materials ensures their availability for future generations and prevents resource depletion, which could lead to scarcity and environmental degradation.

**3. Human Well-being:** Many solid materials directly impact human well-being. For example, preserving clean soil and water sources is essential for agriculture and drinking water supplies. Additionally, the preservation of solid materials helps maintain natural landscapes that contribute to mental and physical health through recreation and aesthetic enjoyment.

**4. Biodiversity Conservation:** Solid materials support diverse habitats that are home to a wide array of plant and animal species. Preserving these materials helps protect biodiversity, which is essential for ecosystem resilience, genetic diversity, and the potential discovery of new resources with medical or industrial applications.

**5. Environmental Stability:** Solid materials play a role in regulating natural processes such as erosion control, water filtration, and climate regulation. Preserving these materials helps maintain environmental stability and resilience in the face of natural disasters and climate change

## OBJECTIVE TEST

1. Which of the following substances can exist in all three states of matter (solid, liquid, and gas) at room temperature and standard pressure?

A.water b.mercury c.carbon dioxide d.iron

2. A gas can be compressed because

A. Gases have always got air in them b. The particles can be squeezed

C. The particles shrink d. There are gaps between the particles

3. A substance with fixed shape is called a

A. Foam b. Gas c. Liquid d. Solid

4. Choose the statement that‘s incorrect

A. All substances are made of particles b. Particles collide

C. Solid, liquids and gas are the three states of materials d. Some liquid do not contain particles

5. During heat conduction in solids

A. The energy in the particles expands b. The particles get cooler

C. The particles loose energy d. The particles pass on energy by colliding

6. In a gas, the particles

A. Are are far apart b. Change size c. Are close together d. Move slowly

## ESSAY

1. A. Name the three states of materials

B. Classify the following under the three state of materials

Brick, diamond, graphite, sand, salt, sugar, chalk, clay, iron, alcohol, honey, syrup, ink, detergent, bleach, coffee, tea, soup, shampoo, conditioner, lotion, perfume, air, steam, smoke, fog, methane, propane, natural gas.

2. A.State three characteristics of each of solid, liquid and gas.

B. Describe the arrangement of particles in solid, liquid and gas.

C. Explain briefly why gas can be compressed

3. A. . Explain briefly why liquid is essential to human life

B. Name two solid materials and state two importance of these materials to humans.

4. A. Explain why solids have a fixed shape but liquids have no fixed shape.

B. Name a liquid, solid, and a gas in your environment. Describe their importance to humans

5. In a tabular form, write three differences between

A. Solids and liquids

B. Liquids and gases

C. Solids and gases

**B7.1.1.2 Understand the periodic table as different elements made up of metals and non-metals and noble gases arranged in an order.**

**The periodic table**

The history of the discovery and use of the elements began with primitive human societies that discovered native minerals like carbon, sulfur, copper and gold (though the concept of a chemical element was not yet understood). Attempts to classify materials such as these resulted in the concepts of classical elements, alchemy, and various similar theories throughout human history. Much of the modern understanding of elements developed from the work of **Dmitri Mendeleev,** a Russian chemist who published the first recognizable periodic table in 1869. This table organizes the elements by increasing atomic number into rows ("periods") in which the columns ("groups") share recurring ("periodic") physical and chemical properties. The periodic table summarizes various properties of the elements, allowing chemists to derive relationships between them and to make predictions about compounds and potential new ones.

***An element*** *is a chemical substance that is made of atoms of only one kind and cannot be broken down into a simpler form*. They are distinguished by a unique atomic number. The elements are organized by their atomic number in the periodic table, which highlights elements with similar properties

Scientist have discovered more than one hundred (100) elements. Each element has its own chemical symbol. Alphabets are used to represent the chemical symbol of the elements. Some elements take the first letter of their name as their chemical symbol and it is written in capital letter. Some of these elements have two letters as their chemical symbol in this case the first letter is written in capital letter and the second letter written in small letter.

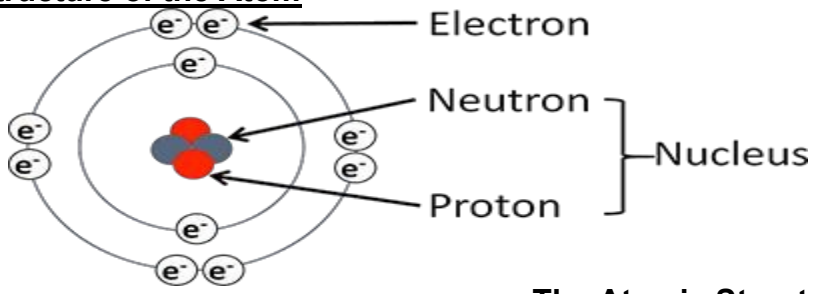
The symbols of the elements are taken 7 from either the English, Latin, Greek, or Hebrew name of the element. Example; sodium (its Latin name is Natrium and the chemical symbol is Na), potassium (Latin name is Kalium, symbol is K), Gold (Latin name is Aurum, its symbol is Au) Among the elements below are the first twenty (20).

**Examples**

| Element | Chemical symbol | Atomic number | |
|---|---|---|---|
| Hydrogen | H | 1 | Hello |
| Helium | He | 2 | Hello |
| Lithium | Li | 3 | Listen |
| Beryllium | Be | 4 | B |
| Boron | B | 5 | B |
| Carbon | C | 6 | C |
| Nitrogen | N | 7 | News |
| Oxygen | O | 8 | On |
| Fluorine | F | 9 | Friday |
| Neon | Ne | 10 | Night |
| Sodium | Na | 11 | Some |
| Magnesium | Mg | 12 | Ministers |
| Aluminium | Al | 13 | Are |
| Silicon | Si | 14 | Selling |
| Phosphorus | P | 15 | Pito |
| Sulphur | S | 16 | So |
| Chlorine | Cl | 17 | Contact |
| Argon | Ar | 18 | Araba |
| Potassium | K | 19 | Pito |
| Calcium | Ca | 20 | Centre |

| ELEMENT | CHEMICAL SYMBOL |
|---|---|
| 1. Gold: | Au |
| 2. Silver: | Ag |
| 3. Mercury: | Hg |
| 4. Iron | Fe |
| 5. Manganes | Mn |
| 6. Zinc: | Zn |
| 7. Lead: | Pb |
| 8. Tin: | Sn |
| 9. Copper: | Cu |

**Structure of the Atom**




**The Atomic Structure**

- The atom is made up of three fundamental or sub-atomic particles namely: protons, neutrons and electrons.
- Protons are positively charged; electrons are negatively charged while neutrons have no charge (i.e. Neutral).
- The protons and neutrons are found in the nucleus of the atom while electrons are found around the shells of the atom.
- Protons and neutrons have a relative mass of 1a.m.u (atomic mass unit) and electrons have ___
- The nucleus occupies the central part of the atom

**Terms Associated with the Atom**

1. **Atomic number / proton number (Z):** The number of protons in a given atom.
   Note: in a neutral atom, proton number equals electron number.

2. **Neutron number (n):** The number of neutrons in a given atom.

3. **Electron number (e):** The number of electrons in a given atom.

4. **Nuclide:** It is an atom with a specified or known atomic number and mass number

**Shells of an Atom**

- K-Shell ……. 1st shell.
- L-Shell …….2nd shell
- M-Shell …… 3rd shell
- N-Shell …… 4th shell

| Type of shell | Maximum number of electrons contained |
|---|---|
| K-Shell | 2 |
| L-Shell | 8 |
| M-Shell | 8 |
| N-Shell | 8 |

**Note:** The total number of electrons a shell can contain is given by the formula 2 , where n is the shell number (i.e. 1, 2, 3, or 4).

**Periodic table** is the arrangement of elements according to their increasing atomic numbers. On the periodic table elements with similar properties are placed in vertical rows (called period) and horizontal columns (called group).

| | GROUP 1 | GROUP 2 | GROUP 3 | GROUP 4 | GROUP 5 | GROUP 6 | GROUP 7 | GROUP 8 |
|---|---|---|---|---|---|---|---|---|
| PERIOD 1 | 1 H | | | | | | | 2 He |
| PERIOD 2 | 3 Li | 4 Be | 5 B | 6 C | 7 N | 8 O | 9 F | 10 Ne |
| PERIOD 3 | 11 Na | 12 Mg | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| PERIOD 4 | 19 K | 20 Ca | | | | | | |
| | Alkali metals | Alkaline earth metals | | | | | Halogens | Noble gas |


**Metals** are element whose atoms donate or give out electron(s) in a chemical reaction. That is, they donate their outermost electrons in order to become stable. They are found on the left side of the periodic table. **Examples of metals are**: Aluminium (Al), copper (Cu), sodium (Na), magnesium (Mg), iron (Fe). Gold (Au), calcium (Ca), lithium (Li), zinc (Zn), silver (Ag).

**Alkaline metals** are elements in group **one** in the periodic table.
They have the following properties:
1. They are highly reactive metals.
2. They have one valence electron, making them very eager to lose that electron and form a positive ion.
3. They have low densities and melting points.
4. They are soft and can be easily cut with a knife.

**Alkaline earth metals** are elements in group **two** in the periodic table.
They have the following properties:
1. They are reactive metals, but less reactive than alkali metals.
2. They have two valence electrons, making them more stable than alkali metals.
3. They have higher melting and boiling points compared to alkali metals.
4. They are harder and denser than alkali metals.

**Reactive metals** these are metals that show reaction with oxygen, water or acid. Examples potassium, sodium and calcium.

**Non-reactive metals** these are metals that do not show any visible reaction with oxygen, water or acid. Example silver, gold and platinum etc.

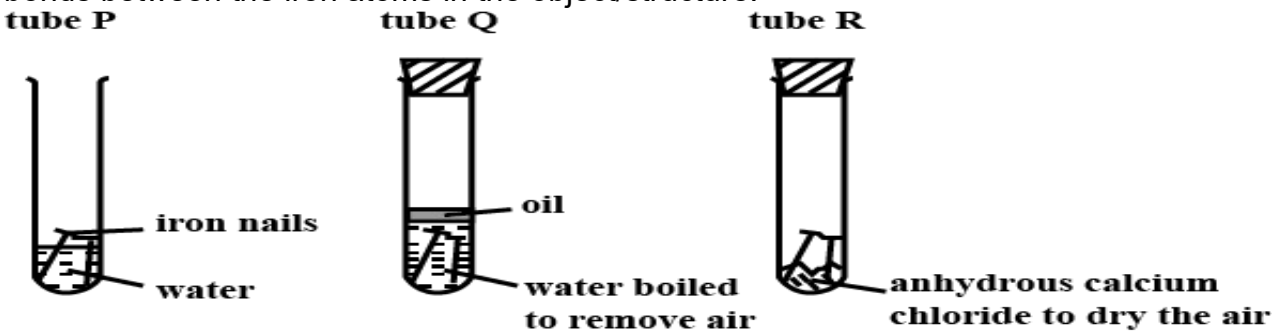
**Properties of metals**
1. Metals are good conductors of heat.
2. Metals are good conductors of electricity.
3. Metals have high melting point
4. Metals have high density
5. Metals are malleable. They can be beaten into any shape
7.Metals are ductile. They can be drawn into a fine wire
9. Metals have high tensile strength. They resist breakage.

**Chemical property of metals**
1. Reactive metals react with oxygen to form metal oxides. Metals donate electrons to oxygen for the formation of metal oxides. For example,
$4K + O_2 \rightarrow 2\ K_2O$

2. Reactive Metals like sodium, potassium, lithium and calcium react vigorously with dilute hcl and $H_2SO_4$ to form their metal salt and hydrogen
Mg + hcl → mgcl₂ + H₂
Fe + $H_2SO_4$ → $feso_4$ + $H_2$

3. Metals react with water to produce hydrogen gas and an oxide.
Mg + $H_2O$ → mgo + $H_2$

**Rusting**
It is the reaction of iron or iron containing substances with water and air to form oxide of iron.
The exposure of iron (or an alloy of iron) to oxygen in the presence of moisture leads to the formation of rust. This reaction is not instantaneous, it generally proceeds over a considerably large time frame. The oxygen atoms bond with iron atoms, resulting in the formation of iron oxides. This weakens the bonds between the iron atoms in the object/structure.




I)**Aim of experiment**
Experiment to prove that both air and water are necessary for rusting of iron or experiment to determine the conditions necessary for the rusting of iron.
Ii) **Reason for boiling the water in test tube Q**
To remove dissolved air.
Iii) **Function of oil on top of the water in test tube Q**
The oil prevents the entering of air into the water.
Iv) Purpose of calcium chloride in test tube R
To remove or absorb all the moisture/water vapour present in the air in test tube C.
V) **Reason why the nail in test tube P rusted**
Because of the presence of air and water.
Vi) α) **Reason why the nail in test tube Q did not rust**
Because of the absence of air (Only water was present)
B) **Reason why the nail in test tube C did not rust**
Because of the absence of water (Only air was present / air is dry)
Vii) **Reason why oil is applied to surface of metail to prevent rusting**
It prevent air/moisture from coming into contact with the metal

**<u>The methods of preventing rusting include:</u>**
1. **Alloying:** Alloying involves incorporating other elements into the metal alloy to form a protective oxide layer. This protective layer helps prevent the underlying metal from reacting with oxygen and moisture in the environment. For example, stainless steel contains chromium, which forms a passive chromium oxide layer that protects the steel from corrosion.

2. **Painting or Coating or oiling:** Applying paint or protective coatings to metal surfaces creates a physical barrier that shields the metal from direct contact with moisture and oxygen. The coating acts as a protective layer, preventing rust formation by inhibiting exposure to corrosive elements.

3. **Galvanizing**: Galvanizing is a process of applying a protective zinc coating to iron or steel to prevent rusting. The zinc coating acts as a sacrificial anode, corroding preferentially to protect the underlying metal from oxidation. This method is commonly used in outdoor structures, such as fences, guardrails, and industrial equipment.

4. **Cathode Protection**: Using electrical current or impressed current systems to protect metal surfaces from corrosion by making them act as cathodes in a corrosion cell.

**<u>Uses Of metals</u>**

1. Gold is used for making ornament and jewellery
2. Mercury is used as a liquid in a thermometer
3. Magnesium is combined with Aluminium to make aircraft bodies
4. Silver is used for making cutlery
5. Iron is used for constructing building, bridges, car bodies and engines

**Alloy**. It is the combination of two or more metals to form a mixture.

**Properties of Alloy**
1. They are harder than the pure metals
2. They are resistant to corrosion
3. They have high tensile strength

**Alloys and their compositions:**

**1. Steel:** Steel is an alloy of iron and carbon, with small amounts of other elements such as **manganese, chromium, nickel, and molybdenum** added to achieve specific properties.

**2. Brass**: Brass is an alloy primarily composed of **copper and zinc**, with additional elements such as lead or tin sometimes included to modify its characteristics.

**3. Bronze:** Bronze is an alloy of copper and typically tin, though other elements such as **aluminum, manganese, or phosphorus** can also be present in varying amounts.

**4. Stainless Steel:** This alloy is primarily composed of **iron, chromium, nicke**l, and small amounts of carbon and other elements to enhance corrosion resistance and strength.

**Corrosion** *is the wearing away of a metal by the actions of acid, alkalis, water, salt water an oxygen.*
This often leads to the degradation of the material's properties and structural integrity.
Common examples of corrosion include rusting of iron and steel, tarnishing of silver, and the breakdown of aluminum.
Corrosion can be caused by various factors such as exposure to moisture, air, acids, or other corrosive substances, and it can occur in different forms, including uniform corrosion, pitting corrosion, and galvanic corrosion.

## Non-metals

**Non-metals** are elements whose elements accept electron(s) in a chemical reaction. That is, they gain electrons in order to become stable. They are found on the right-hand side of the periodic table.
**Examples are**: Hydrogen, carbon, phosphorus, sulphur, oxygen, nitrogen, selenium, and all halogens and noble gases are non-metals.

**Properties of non-metals**

- **Poor conductors of heat and electricity**. This is due to the absence of free electrons available for electrical conduction in non-metals. Except graphite which is a good conductor of heat and electricity.
- **Not lustrous.** This is due to the absence of free electrons in non – metals. Except Iodine which has a slight metallic lustre.
- **Not malleable.** They are brittle. This is due to the presence of very weak interatomic and intermolecular attractive forces.
- **Not ductile.** This is due to the presence of very weak interatomic and intermolecular attractiv forces.
- **Not sonorous.** They cannot produce ring sound.
- **Do not possess tensile strength.** They cannot resist stretching; it will break suddenly.

**Uses of non-metals**
1. Nitrogen is used in the manufacturing of ammonia.

2. Helium is used to fill balloon.
3. Phosphorus is used to make fertilizer.
4. Chlorine is used in the treatment of water. ϖ
5. Oxygen is used for combustion (burning).
6. Argon is used to in fluorescent lamp.
7. Carbon is used as a clue to determine the age of an object

**Difference between metals and non – metals**

| Metals | Non – metals |
|---|---|
| They are usually solids | They are solids, liquids or gases |
| Have high melting and boiling points | Low melting and boiling points. |
| They are malleable | They are brittle |
| They are ductile | Non- ductile. |

**Semi-metals (Metalloids)**

**Metalloids** are elements which exhibit both metallic and non – metallic properties.
Metalloids are **called semi-conductors** because they have slight ability to conduct electricity.
The six commonly recognised metalloids are: **Boron, Silicon, Germanium, Arsenic, Antimony, And Tellurium.**

**Properties of Metalloids.**
- They are usually brittle with shiny surface.
- They are not good conductors (can become excellent conductors if heated or are made slightly impure).
- They are better insulators than metals.

**Uses of Metalloids.**
- They are used for making transistors which are used in radio receivers.
- They are used for making diodes or rectifiers which are used to convert alternating currents to direct currents.
- They are used for making thermostats.
- They are used for making microchips which are essential components of calculators,

**Properties of noble gases:**
1. Inertness: Noble gases are known for their low reactivity and inert nature. They have a full outer electron shell, making them stable and less likely to form chemical bonds with other elements.
2. Colorless and odorless: Noble gases are typically colorless and odorless gases at room temperature. This property makes them useful in various applications, such as lighting and as a protective gas in certain industrial processes.
3. Low boiling and melting points: Noble gases have low boiling and melting points compared to other elements. This characteristic allows them to exist as gases at room temperature and easily transition to a liquid or solid state under specific conditions.
4. Density: Noble gases have relatively low densities compared to other gases. This property makes them lighter than air, which is why helium is commonly used to fill balloons.

**Halogens** are elements in the group seven on the periodic table.
They have the following properties:
1. They are highly reactive nonmetals.
2. They have seven valence electrons, making them one electron short of a stable octet.
3. They have low melting and boiling points.
4. They are diatomic molecules in their elemental form.

## STARND 1: DIVERSITY OF MATTER

## Sub-Strand 2: Living Cells

**Content Standard: B7.1.2.1: Demonstrate an understanding of the structure of organisms and functions of cells in living systems**

**Indicator: B7.1.2.1.1 Describe the structure and function of living cells of an animal, computers, TV sets and radios**

**A cell** is the basic unit of structure and function in a living thing. In other words, a cell is the basic unit of life. Our body is composed of trillions of cells. We have skin cells, muscle cells, nerve cells, blood cells, and many other types as well. Each type of cell has a unique structure and function, but they all share similar characteristics.

**Basic levels of organization in a multicellular organism**

*Cell Tissue Organs organ system Organism*

**Living Cell**. This is the basic or fundamental unit of life. Or it is the building block of life.

**Tissue** .This is a group of cells which are similar in shape and size, and perform the same (specific) function.

**Organ**. This is a Group of tissues of similar functions

**Organ system**. This comprise group of organs that are interrelated and come together to perform the same function.

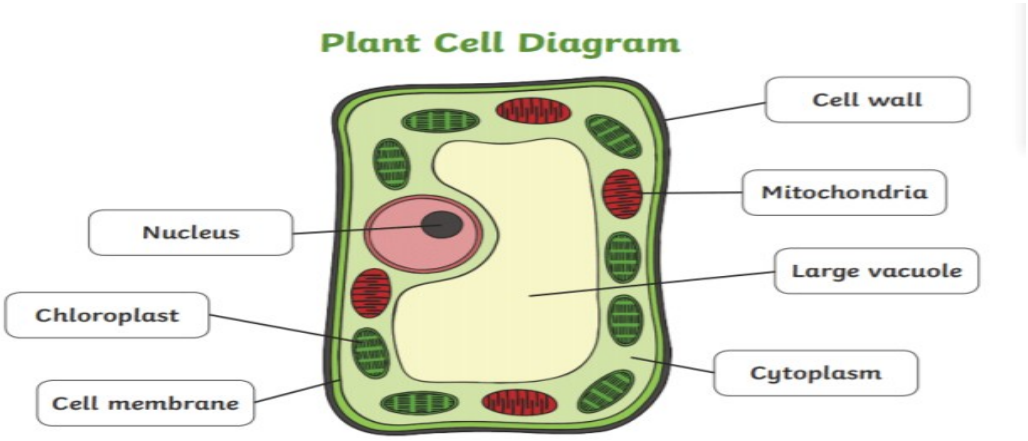
These research works have made us know some important information about cells like the presence of functioning parts/components called ***organelles.*** Each of these components of the cell called organelles have special activities/roles that they play in the overall performance of the cell.

### Plant cells

**Plant cells** are eukaryotic cells, meaning these are cells with membrane-bound organelles.
Plant cells are the basic structural and functional units of plants. They are eukaryotic cells, meaning they have a defined nucleus and membrane-bound organelles. One of the key features that distinguish plant cells from animal cells is the presence of a cell wall, which provides structural support and protection. Additionally, plant cells contain chloroplasts, which are responsible for photosynthesis, the process by which plants convert light energy into chemical energy.

**Features of plant cells**

- They have fixed or regular shape.
- They have cellulose cell wall.
- They have chloroplast containing chlorophyll.
- They have few large vacuoles which are permanent.
- They store carbohydrate as starch




### Organelles found in an animal cell & their function

1. **Cell Wall:** It provides structural support and protection to the cell.
2. **Cell Membrane**: It controls the movement of substances in and out of the cell.
3. **Nucleus:** It contains the cell's genetic material and controls the cell's activities.
4. **Chloroplasts**: They are responsible for photosynthesis, converting sunlight into energy.

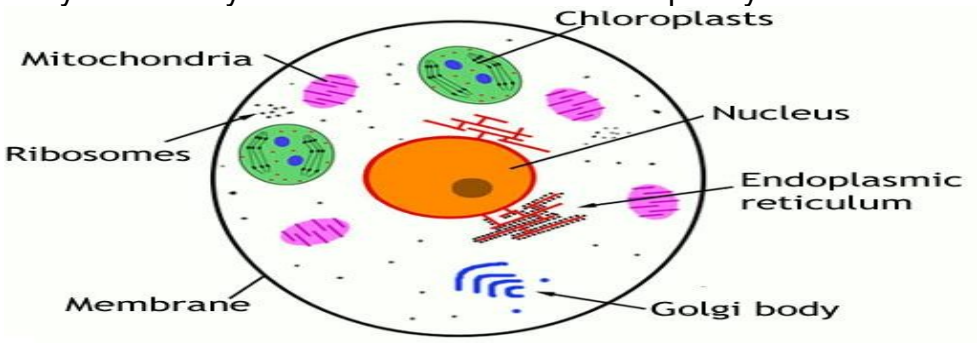
5. **Mitochondria:** They produce energy for the cell through cellular respiration.
6. **Vacuole:** It stores water, nutrients, and waste materials.

## Animal cells

**Animal cells** are eukaryotic cells in which all the organelles are contained in membranes.
The animal cell is a type of eukaryotic cell that makes up the tissues and organs of animals. It has a defined nucleus that houses the genetic material and is surrounded by the cytoplasm, which contains various organelles responsible for different cellular functions. Some of the key organelles found in an animal cell include the mitochondria (responsible for energy production), endoplasmic reticulum (involved in protein synthesis), Golgi apparatus (responsible for processing and packaging proteins), and lysosomes (involved in cellular waste disposal). The cell membrane surrounds the entire cell, providing structure and regulating the movement of substances in and out of the cell.

## Features of animal cells

They have no fixed shape. That is irregular shape.
They have no cell wall
They have no chloroplast.
They store carbohydrate as glycogen.
They have many small vacuoles which are temporary.




## Organelles found in Plant cell & their function

| Organelle | Function |
|---|---|
| Mitochondria | Site for respiration |
| Chloroplast | Contains green pigment or chlorophyll which absorbs sunlight for photosynthesis. |
| Nucleus | Controls all the vital activities of the cell.<br>Contains the genetic materials of the cell. |
| Vacuole | Acts as the store house of water containing various salts.<br>Contains organic substances. |
| Cell wall | Support or protect or gives shape to the cell. |
| Cell membrane | Controls the movement of materials in and out of the cell. |
| Cytoplasm | Sites for chemical reactions in the cell. |

## Similarities between plant and animal cells from above diagram

- They both have cytoplasm
- They both have nucleus.
- They both have cell membrane.
- They both have mitochondrion.
- They both have vacuoles.

## Differences between plant & animal cells

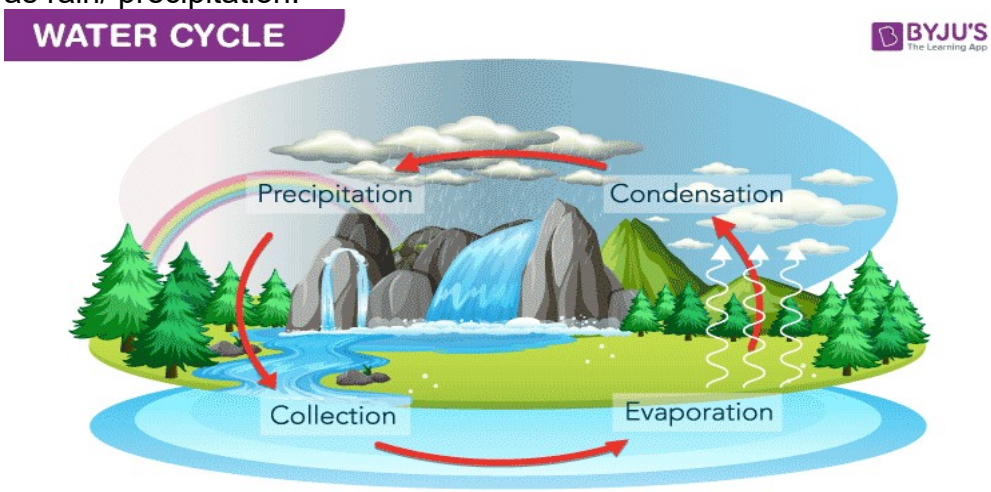
| Plant cell | Animal cell |
|---|---|
| Contains chloroplast or manufactures food. | Chloroplast is absent or does not manufacture food. |
| Cell has definite shape | Cell has no definite shape or irregular shape. |
| Has cell wall | Cell wall absent |
| Contains large, permanent vacuoles | Contains small, temporary vacuoles. |
| Carbohydrate id stored as starch | Carbohydrate is stored a glycogen. |
| Stores lipids as oils | Stores lipids as fat |
| Has cellulose | Absence of cellulose. |

## STRAND 2: CYCLE
## Sub-strand 1: Earth Science
**Content Standard: B7.2.1.1: Recognise that the water cycle is an example of repeated patterns of change in nature and understand how it occurs.**

A study suggests that water originated in rocks from which the Earth was built. Water is now everywhere on earth. That is, in the clouds, the oceans and rivers, even in our bodies. Earth water is always in movement and this natural process is known as water cycle or hydrological cycle.

### Water or Hydrological cycle

**Water or Hydrological cycle** is a set of natural processes that indicate the repeated use and release of water. **OR Water cycle** describes how water evaporates from the surface of the earth into the atmosphere/ cools/ condenses into rain/ snow in the clouds and falls again to the surface of the earth as rain/ precipitation.




**Evaporation**.
This is the initial stage of water cycle. It is the process by which water in its liquid state changes to vapour, a gaseous state. This occurs when the warmth (heat energy) from the sun causes water from oceans, lakes, streams, ice, and soils to increase in temperature and as a result some of the water evaporates into the air and turn into water vapour(gas) which goes up in the sky.
This process include **transpiration from plants**. *The process by which plants lose water to the atmosphere in a form of vapour through their stomata.*

**Condensation.**
Condensation is the process by which a gas (water vapour) is changed into liquid by loss of heat. As the water vapours rise higher, the cooler temperatures make them cool down and turn back into liquid. Wind and air current move the moisture around, leading to the formation of clouds and fog. Stage III:

**Precipitation**.
Precipitation occurs when so much water has condensed that the air cannot hold it anymore. The clouds get heavy and water falls back to the earth with the help of gravity in the form of rain, hail, sleet or snow. Some examples of precipitation include:

**1. Rain**: Liquid water droplets that fall from the sky in the form of rainfall. Rain is the most common type of precipitation.

**2. Snow**: Ice crystals that fall from the sky and accumulate on the ground, forming a white blanket of snow during colder weather.

**3. Sleet:** Frozen raindrops or ice pellets that partially melt as they fall, creating a mix of rain and ice.

**4. Hail**: Round or irregular ice pellets that form within thunderstorms and fall to the ground during severe weather events.

**5. Freezing Rain:** Rain that falls as liquid but freezes upon contact with cold surfaces, creating a layer of ice (glaze) on roads, trees, and other objects.

**Collection.**
*The precipitation either runs off into water bodies such as oceans, rivers, lakes, and even on the ground which in turns becomes part of the groundwater*. After this stage, water is evaporated again and this shows how water cycle has been going on for millions of years, thus bringing fresh water to people, animals, and plants, helping them to survive on earth.

**Transpiration.** *The process by which plants lose water to the atmosphere in a form of vapour through their stomata.* During the process of transpiration, water molecules in the plant tissues are removed from the aerial parts of the plants.

**Ways by which hydrological (water) cycle is important to plants**
- ✓ It produces cooling effects in plants via transpiration.
- ✓ It dissolves oxygen which is available to aquatic plants.
- ✓ It transports, distributes mineral nutrients within the plant.
- ✓ Provides water for dispersal of fruits/ seeds.

**Ways by which hydrological (water) cycle is important to humans and animals**
- ✓ It helps to maintain the Earth‘s total water which sustains animals and humans.
- ✓ The loss of water from humans and animal through perspiration and evaporation cools their bodies.
- ✓ Without the cooling effect of evaporation, greenhouse effect would lead to a much higher surface temperature of 67 , and a warmer planet.

**Water conservation**
Water conservation is the practice of using water efficiently to reduce unnecessary water usage
The purpose of water conservation is to increase the amount of clean water available.

**Methods of Water conservation**
- ✓ Recycling of water in factories.
- ✓ Effective flood control.
- ✓ Treating sewage and factory wastes before disposing them off.
- ✓ Use biodegradable fertilizers and pesticides.
- ✓ Proper utilization of rainwater.
- ✓ Preventing deforestation and encouraging afforestation.

**The importance of water cycle. In terms of:**
**a) Energy Source**: The water cycle plays a significant role in the distribution and release of energy, particularly through the process of evaporation and condensation. When water evaporates from the Earth's surface, it absorbs heat energy from the surroundings, cooling the environment. Later, when the vapor condenses into clouds, this energy is released back into the atmosphere, warming the surrounding air.

**b) Carrier of Nutrients:** Water acts as a carrier of nutrients, transporting vital minerals and organic matter to support plant and animal life. The flow of water in the water cycle helps distribute these nutrients throughout ecosystems, contributing to the growth and sustenance of various organisms.

**c) Improving Water Table:** Through processes such as infiltration and percolation, the water cycle replenishes groundwater reserves, thereby improving the water table. This is essential for maintaining a sustainable supply of freshwater for human consumption and agricultural use.

**d) Regulating Weather Patterns**: The water cycle plays a key role in regulating weather patterns by influencing factors such as humidity, precipitation, and temperature. It contributes to the formation of clouds, precipitation events, and the redistribution of heat across the Earth's surface, thereby impacting global weather systems.

**e) Provision of Clean Water**: The water cycle is instrumental in purifying water through natural processes such as evaporation, condensation, and precipitation. This helps to maintain a supply of clean freshwater for various purposes, including drinking, sanitation, and industrial use.

## STRAND 2: CYCLE

## Sub-Strand 2: Life Cycle of Life Organisms

**Content Standard: B7.2.2.1: Demonstrate The Skills Of Carrying Out Activities To Show The Stages Of The Life Cycle Of Housefly, Effects Of Its Activities On Humans And How To Reduce Them.**

**Indicator: B7.2.2.1.1: Describe the life cycle of the housefly**

### The life cycle of the housefly

A housefly, scientifically known as Musca domestica, is a small insect belonging to the order ***Diptera***. It is commonly found in households and other urban areas. Houseflies have a grayish color with four dark stripes on their thorax. **They have large compound eyes**, *which provide them with a wide field of vision.* Houseflies have two wings and a pair of halteres, which help them maintain balance during flight. They have a sponging mouthpart that they use to feed on various organic materials, including decaying matter, garbage, and sugary substances. Houseflies are known for their ability to transmit diseases as they can pick up pathogens from unsanitary environments and transfer them to food or surfaces. They have a relatively short lifespan of about 15-30 days. Houseflies do undergo ***metamorphosis***, but it is a type of metamorphosis called ***complete metamorphosis***. In complete metamorphosis, the life cycle of a housefly consists of four stages: egg, larva (maggot), pupa, and adult. The larva stage is when the housefly is most commonly seen, and it is during the pupa stage that the transformation from larva to adult occurs

**Metamorphisis** is a biological process in which an organism undergoes a distinct changes in its body structure and form during its life cycles.

**There are two main types of metamorphosis**:

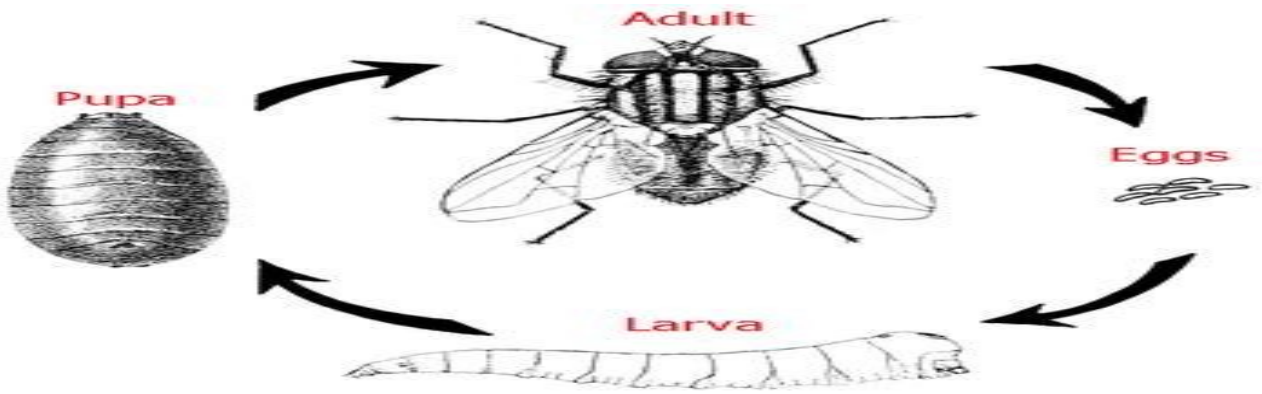
A. Incomplete metamorphosis b. Complete metamorphosis.

**A. Incomplete metamorphosis** is a type of development seen in insects like grasshoppers and dragonflies. In this process, the insect goes through three stages: egg, nymph, and adult. The nymph resembles the adult but lacks wings and reproductive organs. As it grows, it molts several times until it reaches its final adult form. Organisms that undergo incomplete metamorphosis include: Grasshoppers, Crickets, Dragonflies, Damselflies, Cockroaches, Praying mantises, Termites and Mayflies.

**B. Complete metamorphosis**, on the other hand, is a more complex process observed in insects like butterflies, moths, and beetles. It involves four distinct stages: egg, larva (caterpillar or grub), pupa (chrysalis or cocoon), and adult. The larva looks completely different from the adult and goes through a period of transformation inside the pupa before emerging as an adult. Organisms that undergo complete metamorphosis include: Butterflies, Moths, Beetles, Flies, Bees, Wasps, Ants and Mosquitoes.

### Life cycle of a housefly

The order Diptera follows complete metamorphosis (holometabolous). That is their life cycle comprises four stages namely, egg, larva, pupa and adult.



**The Egg – Stage 1**
After fertilization, the female adult flies, lay their eggs in clusters. A female fly can lay up to 300 eggs in one day. The eggs can take from eight to 20 hours to hatch, after which they enter the larval stage.
**The Larvae – Stage 2**
When the eggs hatch, the emerged larvae can also be referred to as maggots. During this stage, the larvae undergo several changes as they grow rapidly. There are three phases or instars in the larval stage. The larvae moult several times by shedding layers of their skin, before each instar stage. Initially, the larvae feed on fluid released from the body.
In their first instar, the larvae measure up to 5 mm in length before shedding their skin. In their second instar, the larvae measure up to 10 mm in length. By the time they reach their third instar, the larvae measure from 15 mm to 20 mm in length.
The time difference between each stage varies; in warmer temperatures, it takes about 3 days and in colder temperatures, it takes eight weeks.
With each moulting and instar stage passing, the larva grows bigger and reaches the pupa stage.

**The Pupa – Stage 3**
In this stage, the white colourless maggots or larvae develop and look similar to adult flies. The pupa looks for a suitable location for this developing stage. During this stage, the pupa fly does not feed and remains stationary.
The pupa is protected via the last, hard larval skin, which encloses the pupa known as the puparium. Under warm temperatures, the pupa takes about four to six days to transform into an adult fly. Metamorphosis occurs during the pupa stage. This is when the larva transforms into an adult fly.

**The Adult – Stage 4**
During this stage, the adult fly emerges from the puparium and is ready to mate. The adult flies are sexually mature and begin the process of mating. Here, the adult fly feeds on the proteins released from body fluids. Unlike the pupa stage where the fly is stationary, when the fly transforms into an adult, they fly to different locations in search of food. After they are done feeding, they mate and eventually search for a suitable spot to lay eggs. The entire process then starts all over again.

**How housefly feeds**
Both male and female flies feed on all kinds of foods including; feeding on

- Dead animals,
- Rotten food
- Garbage and excreta
- Animal dung,
- Manure, solid and liquid wastes. Etc

**Indicator: B7.2.2.1.2: Discuss the activities of the housefly as a menace on humans and show how to reduce the activities e.g. Feeding, reproduction and any other.**

**How the Activities of The Housefly Affect Humans**

The activities of housefly affect humans in the following ways;
**1.Transfer of pathogens:**
The flies pick-up disease-causing organisms(pathogens) while crawling and feeding on filthy matters. Transmission takes place when the fly contacts people or their food.
The diseases that houseflies can transmit include:

(a). Enteric infections: An infection caused by microorganism such as viruses, bacteria, and parasites that cause intestinal illness. These diseases mostly result from consuming contaminated food or dinking contaminated water. Examples include dysentery, diarrhoea, typhoid, cholera, etc

(b). Eye infections such as trachoma and epidemic conjunctivitis.

(c) skin infections such as yaws, and leprosy.

**2. Food poisoning:**

Food poisoning is the illness resulting from eating contaminated food. Most of the diseases are contracted through eating contaminated food and drinking contaminated water. Examples nausea, vomiting, diarrhoea, headache, mild fever, abdominal cramps, etc.

**3. Nuisance in the environment:**

A large numbers of flies can be very annoying because they disturb people at work and at their leisure time. Flies soil the inside and outside of houses with their faeces. They can also have a negative psychological impact because their presence is considered a sign of unhygienic conditions

**How to reduce the activities of housefly**

Below are strategies that can be employed to reduce the activities of houseflies:

1. Reduction or elimination of flies breeding sites

2. Reduction of sources that attract flies from other areas.

3. Prevention of contact between flies and disease-causing germs

4. Protection of food, eating utensils and people from coming into contact with flies

**The importance of houseflies includes**:

**1. Decomposition:** Houseflies help in the decomposition process by feeding on decaying organic matter, which aids in breaking it down and returning nutrients to the environment.

**2. Nutrient recycling:** By consuming and breaking down organic waste, houseflies contribute to the recycling of nutrients, allowing them to be reused by other organisms.

**3. Pollination:** While not as efficient as bees or butterflies, houseflies can also play a minor role in pollination by transferring pollen between flowers.

**4. Food source:** Houseflies serve as a food source for other animals, such as birds, bats, and spiders, contributing to the food chain and ecosystem balance.

**5. Research:** Houseflies are commonly used in scientific research, particularly in genetics and developmental biology, due to their short life cycle and ease of breeding.

## STRAND 2: CYCLE
## Sub-Strand 3: Crop Production Content Standard:
## B7.2.3.1: Demonstrate An Understanding Of The Different Plant Nutrients (Organic, And Inorganic Fertilizers) And Their Application In School Farming.

**Plant nutrients** are essential elements that plants need in order to grow and thrive. They are required in varying amounts and play important roles in various plant functions. Some examples of plant nutrients include:

1. Nitrogen (N): Nitrogen is important for plant growth and is a key component of proteins, enzymes, and chlorophyll. It helps in leaf and stem development.
2. Phosphorus (P): Phosphorus is involved in energy transfer and storage within plants. It is essential for root development, flowering, and fruiting.
3. Potassium (K): Potassium is important for overall plant health and plays a role in regulating water uptake, photosynthesis, and nutrient transport within plants.
4. Calcium (Ca): Calcium is necessary for cell wall structure and stability. It also helps in root development and nutrient uptake.

**Fertilizers.** This is a substance or material that is applied to plants or soil to supply nutrient

### Types of fertilizer or plant nutrient source
There are mainly two groups:
1. Organic nutrient
2. Inorganic

**A. Organic fertilizer.** They are manures or decomposed organic matter derived from plant and animal sources. Examples are: Farm yard manure, Poultry manure, Cow dung, Compost, green manure.
Manure is organic materials used as fertilizer to provide nutrient for plants. It is made up of animal waste, such as dung and urine, as well as plant material. Manure is rich in nutrients that can help improve soil fertility and promote plant growth

### Factors that affect the choice of manure
- The types of crops to be grown
- The physical or chemical properties of the soil
- Availability of the manure
- The prevailing climate and weather conditions.

### Types of manure
**1.Green manure:** This is the formed from leguminous crops or other fresh plants which are ploughed into the soil while they are still growing.

**2.Farmyard manure:** This is a combination of animal wastes or animal beddings.

**3.Compost** is a type of organic matter that is created through the decomposition of various organic materials, such as food scraps, yard waste, and other biodegradable materials. It is a natural process where microorganisms break down the organic matter, resulting in a nutrient-rich soil amendment. Compost is commonly used in gardening and agriculture to improve soil quality, retain moisture, and provide essential nutrients for plants. It is an environmentally friendly way to recycle organic waste and reduce the need for chemical fertilizers.

**Starters.** Are materials that help kickstart the decomposition process in a compost pile. *They provide the necessary nutrients and microorganisms that break down organic matter into nutrient-rich compost.* Some common starters include fruit and vegetable scraps, coffee grounds, tea bags, and crushed eggshells.

### Methods of composting
I. **Pit method**
Pit composting is a method of composting where organic materials are placed in a pit or hole in the ground. This method involves digging a pit or trench, usually about 1-2 feet deep, and filling it with a mixture of organic waste, such as food scraps, yard waste, and other biodegradable materials. The pit is then covered with soil or a layer of straw to help retain moisture and promote decomposition

**Ii. Stack or Heap methods**
The heap method of composting involves creating a large pile or heap of compost materials. This method requires less maintenance and turning compared to the stack method. It is commonly used for smaller-scale composting or home composting.

**Organic materials that can be added to the compost**
1. Cut grass 2. Leaves 3. Maize stover 4.. Lawn chippings 5 animal manure

**Principles involved in composting**

1. Site selection
2. Gathering of compost materials
3. Waste management
4. Aeration the compost
5. Monitoring the compost
6. Include starters

**Importance of composting**

1. Reduces waste
2. Decreases greenhouse gas emissions
3. Improves soil fertility
4. Retains moisture in the soil
5. Suppresses pests and weeds

**Characteristics Of organic fertilizers**.

1. Organic nutrients are made up of different plant residue.
2. Organic fertilizers have no effect on soil microorganisms.
3. They are rich in humus.
4. They are bulky.
5. They improve the structure of the soil.
6. They improve soil aeration.
7. Protect the soil against wind and water erosion.

**Advantages of organic fertilizers over inorganic fertilizers.**
- Organic fertilizers have a more lasting effect in the soil.
- They are not easily leached.
- They improve soil structure.
- They are comparatively cheaper.
- They improve water holding capacities of soils.
- They have buffering capacity through cation exchange or they regulate soil acidity or alkalinity.
- They provide energy or food to the soil living micro-organisms.
- Make the soil less compacted aiding in the increase of air in the soil.
- Serves as mulch for soils.

**Ways in which organic fertilizer is important to the soil.**
- It adds specific nutrient to the soil.
- It improves soil structure/ ability of soil to hold water or nutrients.
- It improves soil aeration.
- It enhances the activities of soil organisms.
- It is cost effective.
- Threat to plant damage is reduced.
- It works slowly.
- It is environmentally friendly.

**B. Inorganic Fertilizers or plant nutrients**
This is any man-made chemical substance/ fertilizer which releases nutrients for plants use. They are fertilizers or chemical substances synthesized from inorganic substances by using chemical procedures or processes
**Examples are:** NPK, Sulphate of Ammonia, Urea, potassium nitrate, rock phosphate, sodium nitrate, calcium nitrate, ammonium nitrate.. NPK, Sulphate of ammonia, Muriate of potash.

**Characteristics of Inorganic fertilizers.**
1. They usually contain few nutrients-nitrogen, phosphorus, potassium and sometimes micronutrients either singly or in a combined form.
2. They do not improve the structure of the soil.
3. They do not check erosion.

**Types of Inorganic Fertilizers**
**1.Straight or single fertilizer and compound fertilizers.** Straight/Simple/Single fertilizer:

These are fertilizers consisting of only one of the major plant nutrients. The nutrient may be Nitrogen (N) or Phosphorus(P) or Potassium(K). Examples: Muriate of potash, Sodium nitrate, urea and ammonium sulphate.

**2. Compound or Mixed fertilizers**
These are fertilizers that are made up of two or more major plant nutrients present in their appropriate percentages. Examples: NPK 15:15:15, NPK 20:20:20 and NPK 10:20:10.

**Effects of improper application of inorganic fertilizer**
- It leads to pollution of the soil or surrounding water bodies or makes soil acidic.
- Reduces economic value of crops.
- Destroys the growth of soil micro-organisms.
- Poor growth and development of crop plants.

**Factors to be consider before the application of fertilizers to the crop.**
- Time of application or stage of development of the plant.
- Condition of soil or ph of soil or water holding capacity of soil.
- Level of weed control.
- Economic value of the crop.
- Texture of the soil or type of soil.
- Nature of the crop.
- Weather conditions.

**Disadvantages of using chemical fertilizers.**
- They leach easily.
- They increase soil acidity.
- They are injurious to soil living organisms or crops when not used correctly.
- They drain into water bodies resulting in pollution.
- They destroy soil structure..

**Classification of Plant Nutrients**
1.**Macro or Major Nutrients** They are nutrients or elements which are required by plants in large quantities for efficient performance. The macro nutrients are; Nitrogen, phosphorus, potassium, calcium, magnesium and Sulphur.

2.**Micro or Minor nutrients** These are the elements that are required by plants in small quantities for growth.The micro nutrients are:Chlorine, Boron, Manganese, iron, Copper, Zinc, Molybdenum.

**A. Functions of Nitrogen (N)**
- Chlorophyll formation.
- Formation of protein/enzymes/ nucleic acid.
- Increase yield.
- Promote growth in plant.

**Symptoms**
- Chlorosis (yellowing) of old leaves,
- Stunted and slow growth of plants.
- Necrosis of older leaves in severe cases
-

**B. Functions of Phosphorus (P)**
- Promotes flowering/seed formation.
- Helps in stalk development.
- Helps in root/ tuber development.
- Improves plant's resistance to disease.
- Responsible for early maturity of plants.
- Speeds up ripening of fruits.
- Helps to regulates plant metabolism/ respiration.

**Symptoms**
- Stunting of green plants.
- Older leaves have purple colour.
- Slender stems in grass pants.
- Poor roots and bark development

**C. Functions of Potassium (K)**
**Potassium (K)** is utilized by plants in the activation of enzymes, photosynthesis, protein formation and sugar transport.
**Symptoms**
- K deficiency does not immediately result in visible symptoms (hidden hunger).
- Initially, there is only a reduction in growth rate, with chlorosis (yellowing) and necrosis (brown or death of tissues) occurring in later stages

- Affected older leaves will show localized mottled or chlorotic areas with leaf burn at margins

**D. Function of Manganese (Mn):**
Regulation of oxidation – reduction reaction in plants; catalyst in chlorophyll activities.
**Symptoms:** The top of young leaves shows yellowish green discoloration.

**E. Function of Iron (Fe):**
Formation of chlorophyll
**Symptoms:** Poor growth and yellowing of leaves.

**Methods of fertilizer application**

- **Side dressing:** the fertilizer is applied as a second application to the side of the base of the plants already in the field.
- **Broadcasting**: the fertilizer is spread as uniformly as possible over the field.
- **Drilling or band placement method:** the fertilizer is applied with a drill at the same time as sown.
- **Foliar or spraying method:** the special liquid fertilizer is diluted to the required concentration before it is applied to the leaf of some plant.
- **Ring method**: the fertilizer is applied in a circular way equidistant from the plant. Fertilizer is not made to touch the plant.
- **Plough sole method:** the fertilizer is placed in a continuous band at the bottom of the plough furor. Each band is covered as the succeeding furrows are turned over.
- **Fertigation method.** The fertilizer is applied to the plants through irrigation process.

**Differences between organic and inorganic plant nutrients**

| Organic | Inorganic |
|---|---|
| Large non-nutrient content | High concentration of nutrients |
| Bulky | Ease of transport |
| Little direct cost | Increasing cost |
| Imprecise content analysis | Made from finite resources |
| No direct energy use in manufacture | Large direct energy use in manufacture |
| Readily available | Availability depends on production, cost and region |
| Provides disposal of wastes | Creates wastes in processing, but can also utilize wastes from other manufacturing processes |

## STRAND 2: CYCLES
## SUB-STRAND 4: ANIMAL PRODUCTION
**Examine and list domestic animals in the community**

**Domestic animals**-They are animals that have been domesticated. They include; livestock and poultry (cattle, sheep, goat, chicken, duck, turkey).

**Characteristics /Features of domestic Animals.**
A. They grow and mature quickly, making them efficient to farm.
B.They eat plant-based diet, which makes them inexpensive to feed.
C. They breed easily in captivity and undergo multiple periods of fertility in a single year.

**A breed** *refers to a specific group of animals that share similar characteristics and traits.* These characteristics can include physical appearance, behavior, and production capabilities. Different breeds of farm animals have been selectively bred over time to enhance certain desirable traits, such as high milk production in dairy cows or fast growth in meat-producing animals. Examples of farm animal breeds include Holstein cows, Hampshire pigs, and Rhode Island Red chickens

**Domestic animals can be classified into**
Animals with a
***1. Simple, one- chamber stomach* is called non-ruminant or monogastric animals**
Examples of monogastric herbivore include pigs, rabbits, horses, and hamsters.

2. Other animals or mammals like cattle, sheep, goats, deer, antelope, giraffes, and camels have stomach which has *four chambers (rumen, reticulum, omasum and abomasum*) and they are called **ruminants or poly gastric**.

**3. Poultry**

**1. Non-ruminant or monogastric animals**

**A monogastric** organism has a simple single-chambered stomach (one stomach) or a monogastric is an animal with a single-compartmented stomach. Examples of monogastrics include humans, poultry, pigs, horses, rabbits, dogs and cats. Most monogastrics are generally unable to digest much cellulose food materials such as grasses

**Rabbit production**
**Breeds of rabbit.**

- California white.
- Flemish giant.
- .
- Angora.
- New Zealand Red

**Factors to consider when selecting rabbits for breeding.**
Type of breed

- Adult size
- Length of fur
- Colour of fur
- Healthy or vigorous
- .
- Body confirmation.
- Fertile or high libido
- Sex of the animal

**Diseases that affect rabbits**

- Coccidiosis
- Mange or ear canker
- Warbles
- Calicivirus
- Cold
- Common diarrhea.

**2. Ruminants or polygastric animals**

*They are farm animals which have complex stomach and chew their cuds*.

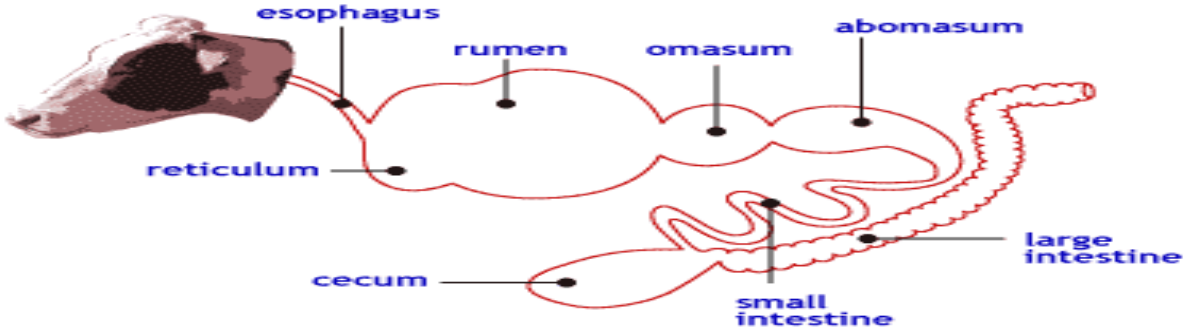
Examples include cattle, deer, antelope, giraffes, and camels, sheep and goats. Ruminants bring up food from their stomach to chew more thoroughly when they are resting. This habitat is known as chewing the cud. Cud-chewing is an adaptation that enables many hoofed mammals (ruminants) to break down the cellulose of plant cell walls into nutrients before they can absorb them.
The stomach is made up of four chambers, namely rumen, reticulum, omasum and abomasum.

**The rumen** is the first chamber and largest of the stomach. The rumen is the largest compartment of the stomach in ruminant animals such as cattle, sheep, and goats. It is a specialized fermentation chamber where microbial digestion takes place. The rumen allows these animals to efficiently digest plant material, particularly cellulose, which is otherwise indigestible by many other animals.
Within the rumen, a complex community of microorganisms, including bacteria, protozoa, and fungi, work together to break down the fibrous plant material through fermentation. This process produces volatile fatty acids and other by-products that can be utilized by the animal as a source of energy and nutrients.

**The reticulum** is an additional storage space for food and conditions within it are similar to that of the rumen. The reticulum is compartment of the stomach and is located just behind the diaphragm. It is often referred to as the "honeycomb" due to its unique honeycomb-like structure. The reticulum acts as a holding chamber for food and also assists in the process of regurgitation during rumination.

**The omasum** has strong muscular walls which are used to squeeze water from the food before it enters the abomasum. The omasum is the third compartment of the stomach and is responsible for further processing and absorption of water from the partially digested food. It contains numerous folds and papillae that increase its surface area, allowing for greater absorption of water and some nutrients. The omasum is often likened to a book with many pages due to its appearance.

**The abomasum is** the **true stomach** where gastric juice is secreted for protein digestion. The abomasum is the fourth compartment of the stomach and is functionally similar to the stomach of non-ruminant animals. Often referred to as the **"true stomach,"** it secretes gastric juices and enzymes that aid in the breakdown of proteins, fats, and carbohydrates. The abomasum is where most of the enzymatic digestion occurs, similar to the human stomach.




## Sheep production

Sheep are unique ruminants with hollow horns and even toes .They are easier to herd than the goat

**Common breeds;**

West Africa Dwarf sheep, Nungua black head, Quda Fulani breed, Yankasa

**Exotic breeds of sheep**

Austrilian Merino, Spanish Merino, Quda , Finish landrace

## Characteristics of West African Dwarf Sheep

- Short and small in size
- Have long neck and narrow ears
- Have compact body
- Tolerant to trypanosomiasis

**Characteristics of Nungua Black Head**

- Hybrid between black Persian breed from
- South Africa and West Africa dwarf breed
- Does well in coastal areas
- Has white body and a black head

**Differences between a goat and a sheep**

| Goat | Sheep |
|---|---|
| Has a short, usually erect tail. | Has longer, hanging tail. |
| Both the male and female can be bearded | Only the adult male sheep or ram is bearded. |
| Heels have rubber-like pads | No rubber like pads |
| The male goat has an odour | Absence of odour in the male sheep |
| Absence of glands between the toes. | Presence of glands between the toes. |

**Reasons why goats are not normally kept under the intensive system of management**

- Goats are naturally very aggressive.
- Their growth rate reduces when they are confined.
- They are highly selective in feeding.
- To increase resistance to diseases (due to exercise).

**Cattle production**

**Dairy cattle**

They are cows raised purposely to produce milk.

**Breeds of dairy cattle**

Friesian, Aystine, Holstein, Zebu, Jersey

**Characteristics of Dairy cattle**

- They are well-developed or large udder.
- Have quiet character or docile.
- They are wedged-shaped or triangular in shape.
- Large body capacity
- Have thin or long legs
- Have slow growth rate.

**Breeds of beef cattle**

Aberdeen, Zebu, n'dama, West African short horn, Angus, Muturu, White Fulani

**Body conformation of Dairy cattle**

- They are wedge – shaped.
- Body supported by fairly long limbs.
- They have well developed udder.
- Their body is lean or not fleshy.
- They have long and slender legs.
- Wide space between the hind legs.

**Body conformations of Beef cattle**

- They have blocky or square – shaped body.
- Stocky and well filled with flesh.
- Body supported by short, strong limbs.
- Has less developed udder.

**Diseases that affect cattle.**

- Anthrax
- Rinderpest
- Foot and mouth disease
- Brucellosis
- Mastitis
- Bloat
- Trypanosomiasis or sleeping sickness.

**Products obtained from cattle industry**

- Beef
- Milk
- Hide or skin
- Glue from horn and hoof
- Yoghurt
- Cheese.

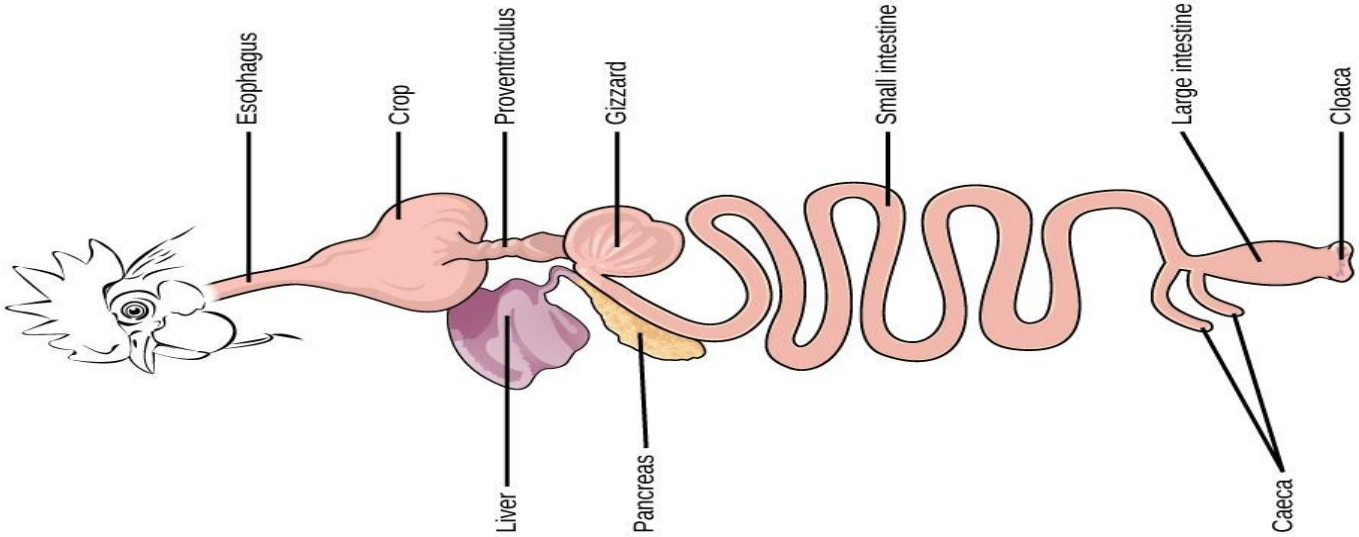
## 3. POULTRY PRODUCTION

**Poultry** refers to a class of domestic birds reared for meat and or their eggs.

**Functions of the parts of Digestive system of a fowl**

- **Proventriculus or true stomach:** This stores food or digestion of food.
- **Colon or large intestine:** Reabsorption of water.
- **Cloaca:** Exit for excretory or undigested food.
- **Small intestine:** Digestion of food or secretion of enzymes to digest starch or protein.
- **Crop:** This store food temporarily before moving it on to the stomach.

**Ventriculus or gizzard:** This stores food and water or moistens food




**Importance of poultry production**

- Provision of food or meat for human consumption.
- Provision of employment.
- Provision of income.
- Manure from poultry house used as fertilizer.
- Stuffing of pillows
- Colourful feathers of poultry can be used for decorating cloths and hats.

**Breeds of Poultry**

**Types of breeds;**

- Local .Exotic

**Characteristics of Local Breeds**

- Hardier
- More resistance to disease and heat stress
- Smaller in size, produce fewer and smaller eggs

**Characteristics of exotic breed or domestic chicken**

- Grow very fast
- Long body size and produce larger eggs
- Used for commercial eggs or meat production

**Examples of exotic breed or domestic chicken of fowl**

- Rhode Island red
- Light Sussex
- White leghorn
- .
- New Hampshire
- Dark Cornish
- Plymouth rock

**Advantages of Exotic breed of birds over Local breed.**

- They are larger in size.
- They lay bigger eggs.
- They lay more eggs.
- They grow faster.
- They have tender meat.

**Differences between the foreign (Exotic)breed of fowl and the Local breed of fowl**

| Foreign (Exotic) breed | Local breed |
|---|---|
| Large in size | Smaller in size. |
| Fast grower | Slow grower |
| It is not broody | Brooder |
| Do not exhibit parental care | Exhibit parental care |
| Produce more or bigger eggs. | Produce less or smaller eggs |

## Classification of breeds of fowl

The three main classes of fowl based on their economic values are:

**1. Layers (egg-producing breeds):** these are fowls reared for the purpose of producing eggs. Examples are Single Comb White Leghorn, Minorca, ISA layer, Nora Sexlink and Goldline 54.

**2. Broilers (meat-producing breeds):** these are fowls reared for the purpose of producing meat. Examples include Dark Cornish, Jersey Black Giant, Hypeco broiler, and Marshall broilers.

**3. Dual purpose breeds:** these are fowls kept for the purpose of producing both eggs and meat. Examples; Rhode Island Red, New Hampshire Red and Australorp.

## Characteristics of a good laying hen

- Large space between pelvic and breast bones.
- Oval or moist or warm vent.
- Bright or red large comb or wattle.
- Large or bright eyes.
- Bright plumage.
- Feathers dirty or ragged looking.
- Normally active or alert to her surroundings.

## Reasons why poultry farms should be distance from residential areas.

- To prevent obnoxious gases (ammonia) from entering people‘s houses.
- To avoid disturbance from noise of poultry.
- To enable fowls to receive enough natural air.
- For the avoidance of dust spread into the pens.
- For avoidance of transfer of diseases into the pen.

## Diseases that affects poultry

- Newcastle disease
- Coccidiosis
- Gumboro
- Perosis
- Fowl pox.
- Ring worm

## Importance of farm animals

**1. Food Production**: Domestic animals such as cows, chickens, pigs, and goats are valuable sources of meat, eggs, milk, and other animal-derived products, contributing to global food security and nutrition.

**2. Agricultural Work:** Animals like horses, oxen, and water buffalo have historically been used for plowing fields, transporting goods, and performing other agricultural tasks, aiding in farm productivity.

**3. Companionship**: Many domestic animals, including dogs and cats, provide companionship and emotional support to humans, contributing to mental well-being and reducing stress.

**4. Fiber and Textiles**: Animals like sheep and alpacas produce wool and other fibers used in textile production, providing materials for clothing, blankets, and other essential items.

**5. Manure Production:** Animal waste serves as a natural fertilizer for crops and contributes to soil fertility and agricultural productivity.

**6. Cultural Significance:** Domestic animals are deeply ingrained in many cultures and traditions, playing roles in ceremonies, rituals, and symbolic representations of heritage.

## Common domestic animals and their by-products:

1. Cows: By-products from cows include leather, which is used in the production of various goods such as shoes, belts, and furniture. Additionally, cow hooves and horns can be processed into items like buttons, combs, and glue.

2. Chickens: By-products from chickens include feathers, which are used in various products such as pillows, bedding, and jackets. Chicken manure is also used as a natural fertilizer for crops.

3. Sheep: In addition to wool, sheep provide by-products such as lanolin, a waxy substance extracted from wool that is used in cosmetics and skin care products.

4. Goats: In addition to milk, meat, and fiber, goats also provide by-products such as goat skin, which is used to make leather goods.

5. Pigs: By-products from pigs include materials like bristles (hair), which are used in brushes and brooms. Pig fat is also used in the production of soaps and candles.

6. Horses: Horse by-products include items such as horsehair, which is used in upholstery, musical instrument bows, and brushes. Additionally, horse bones can be processed into glue and gelatin.

## STRAND 3: SYSTEMS.

## Sub-Strand 1: The Human Body System

**Content Standard:B7.3.1.1 Show An Understanding Of The Concept Of Food, The Process Of Digestion And Appreciate Its Importance In Humans.**

**Indicator: B7.3.1.1.1 Explain the concept of food and the needs for humans to eat.**

**Food** is any substance, solid or liquid which provides the body with materials for

- heat and energy
- growth and repair
- regulation of body processes such as metabolic activities examples excretion, respiration, reproduction, nutrition and movement.

These food substances include; cassava, bread, meat, milk, yam, plantain, eggs, ground nut, butter, salmon, sardine, vegetables, orange, —kontomirell, beans, etc. The useful materials that food provide to the body are known as nutrients.

**Classification of nutrients**

All the different kinds of foods that we eat can be classified into the following on the bases of the type of nutrient they contain:

I. Carbohydrates (starch and sugar)
Ii. Protein
Iii. Mineral salts
Iv. Fats and oils
V. Vitamins

**Importance of food to human.**

I. Food helps the body to acquire energy.
Ii. Food helps the body to grow and develop.
Iii. Food helps the body to maintain and repair worn out tissue.
Iv. Food helps to protect the body against diseases.

**Egestion** This is the removal of undigested food (faeces) from the anus.
**Absorption** This is a process whereby simple molecules that result from chemical digestion pass through cell membranes of the lining in the small intestine into the blood or lymph capillaries.
**Assimilation** This is the movement of digested food molecules into the cells of the body where they are used.
**Emulsification** is the process of breaking down large fat droplets into smaller droplets to make it easier for the body to digest and absorb fats

***The process of digestion***

The process of digestion is the way our bodies break down food into smaller molecules that can be absorbed and used for energy and nutrients. It involves both mechanical and chemical processes.

1. Mouth: Digestion begins in the mouth where food is chewed and mixed with saliva, which contains enzymes that start breaking down carbohydrates.
2. Oesophagus: The chewed food then travels down the oesophagus to the stomach through a process called swallowing. Peristalsis in the esophagus is a series of coordinated muscle contractions that propel food from the mouth to the stomach. When we swallow, the muscles in the walls of the esophagus contract and relax in a rhythmic wave-like motion, pushing the food downward. This movement helps to move the food through the esophagus and into the stomach, where digestion can continue
3. Stomach: In the stomach, food mixes with gastric juices containing enzymes and acids that continue breaking down food into a soupy mixture called chyme.

4. Small Intestine: The chyme moves to the small intestine where further digestion occurs with the help of enzymes from the pancreas and bile from the liver. ***Nutrients are absorbed into the bloodstream through the walls of the small intestine***.
5. Large Intestine: Any remaining undigested food passes into the large intestine where water and minerals are absorbed, and waste is formed into feces.
6. Rectum and Anus: Feces are stored in the rectum until they are eliminated through the anus in a process called defecation.

**Anatomy of Digestive system**

The digestive system consists of the upper and lower alimentary canal and the accessory digestive organs.
**1. The alimentary canal** is a continuous tube that extends from the mouth to the anus. Most of its length is made up by the **The upper canal** consists of the mouth, part of the pharynx, the oesophagus, and the stomach; whereas the **lower tract** is made up of the small and large intestines.
**2. The accessory organs** of the digestive system include the salivary glands, the teeth, the liver, the pancreas, and the gall bladder.

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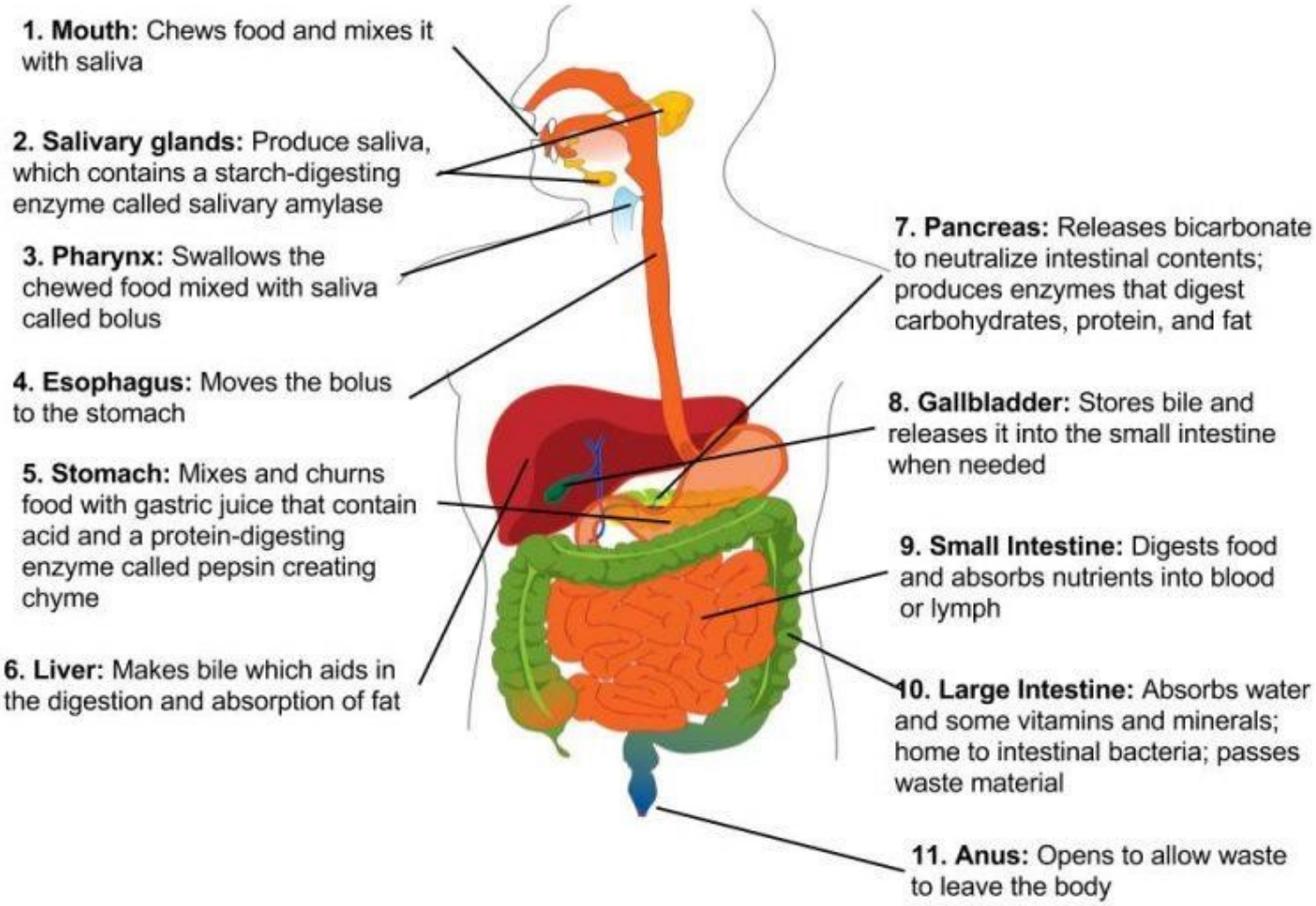



**Process of fat digestion in human**

- Fats digestion start in the duodenum.
- Gall bladder releases bile into the duodenum.
- Bile emulsifies the fat.
- An enzyme (lipase) is secreted by the pancreas and the lining of the small intestine.
- Lipase converts the emulsified fat to fatty acid and glycerol.

**How food get absorbed in the body of humans**

*Food is absorbed in the body through the process of digestion and absorption. When you eat, the food travels through your digestive system, where it is broken down by enzymes and acids. Nutrients from the food, such as sugars, amino acids, fatty acids, vitamins, and minerals, are then absorbed through the walls of the small intestine and transported to the bloodstream.*

From there, these nutrients are carried to different parts of the body to provide energy and support various bodily functions. It's a fascinating process that allows our bodies to make use of the nutrients in the food we eat!

**End – product of digestion**

| Food | End – product |
|---|---|
| Carbohydrates | Glucose or simple sugar or fructose or galactose. |
| Protein | Amino acids |
| Fats | Fatty acid and glycerol |

**How the end-product of digestion of fats and oils is absorbed in humans**

- Fatty acids and glycerol are the end products of digestion of fats and oils.
- They are absorbed through the walls of villi or small intestines by diffusion into the lacteals.

**Why digestive system is necessary in humans**

To break down food so that it can be used by the body for energy, cell growth and repair.

**Effects of increased salt diet**

✓ High blood pressure or hypertension or stroke.
✓ Heart attack or diseases or disorders.

**Effects of over-eating**

✓ High blood pressure
✓ Diabetes
✓ Heart diseases
✓ Stroke
✓ Obesity or overweight

**Indigestion** This occurs when complex organic molecules or food substances fail to break down into simpler substances.

**Causes of indigestion**

✓ Eating at irregular times.
✓ Improper chewing
✓ Over eating
✓ Heavy smoking
✓ Emotional stress and stomach ulcer.

**Ways of preventing indigestion**

✓ Food should be well cooked
✓ Food should be chewed properly
✓ Avoid oily and fatty foods.
✓ Avoid eating late at night.

**Digestive Enzymes** They are biological or organic catalysts that are in smaller quantities that helps in breaking down food substances in the body.

**Characteristics of enzymes**

- They are made up of proteins.
- Overheating or excessive heating destroys enzymes.
- Their reactions are reversible.
- Some are activated by co-enzyme.
- They work best within a specific or certain range of ph.

**Factors that affect the action of enzymes**

A. Temperature, b. Enzyme concentration,
C. Product concentration, d. Inhibitors or activators.

**Examples of digestive enzymes**

- Salivary amylase or ptyalin.
- Pancreatic amylase
- Maltase
- Sucrose
- Lipases
- Protease like pepsin, rennin, trypsin, erepsin, peptidase.

| Name of enzymes | Parts of human body where it is produced |
|---|---|
| Ptyalin | Salivary gland |
| Amylase | Pancreas, small intestine. |
| Pepsin | Stomach |
| Rennin | Stomach |
| Trypsin | Small intestine |
| Lipases | Pancreas, small intestine. |

**Disorders of the digestive system**

- Jaundice
- Peptic ulcer diseases
- Hepatitis
- Constipation: This is a common condition that affects people of all ages. It can mean that you are unable to open your bowels as regularly as usual.

**Causes of constipation**

- Lack of exercises
- Absence of roughage in diet
- Absence of fruits and vegetables in diet
- Intake of too much dry food.

**Treatment of constipation**

- Increase your daily intake of fibre.
- Drink plenty of fluids.
- Get more exercise.
- Do not ignore the urge to open your bowels.

**Diseases/ disorders that affect the liver**

- ✓ Jaundice
- ✓ Gall stones
- ✓ Hepatitis B
- ✓ Liver cancer

**Perform practical test on food: starch, glucose, protein and fats and oils**

**Test for starch (Carbohydrate)**

**1. Test for Starch**

Starch is a carbohydrate commonly found in many foods, particularly those derived from plants. Some examples of foods that contain starch include:

1. Potatoes: Potatoes are a good source of starch, especially when they are cooked.

2. Rice: Rice, particularly varieties like white rice and jasmine rice, contains starch.
3. Bread: Wheat-based products like bread and other baked goods contain starch.
4. Pasta: Pasta made from wheat flour is another example of a starchy food.
5. Corn: Corn and corn-based products, such as cornmeal and tortillas, are rich in starch.
6. Legumes: Foods like beans, lentils, and peas also contain significant amounts of starch.

**A few drops of iodine solution is added to starchy food. *A <u>blue-black</u> colour indicates the presence of starch.***

**2. Test for Simple/Reducing Sugars**

Reducing sugars are a type of sugar that can donate electrons to other compounds, often used in various chemical reactions. Some common examples of reducing sugars include:

1. Glucose: Glucose is a simple sugar and one of the most common reducing sugars found in nature. It is a primary source of energy for living organisms.
2. Fructose: Another simple sugar, fructose is commonly found in fruits, honey, and some vegetables. It is also a reducing sugar.
3. Lactose: Lactose is a disaccharide sugar found in milk and dairy products. It consists of glucose and galactose and is considered a reducing sugar.
4. Maltose: Maltose is a disaccharide formed from two glucose units linked together. It is found in germinating grains and is considered a reducing sugar.

**a. Benedict's Test**

Few drops of Benedict's solution is added to the sample (glucose). The mixture is boiled. **Brick-red** colour indicates the presence of a reducing sugar.

**b. Fehling's Test**

**Drops of Fehling's reagent is added to a sample containing reducing sugar. The mixture is shaken thoroughly and heated. *An <u>orange-red</u> colour indicates the presence of a reducing sugar.***

**3. Test for Non-Reducing Sugars**

**<u>Non-reducing sugars</u>** are carbohydrates that do not have the ability to donate electrons to other compounds. Some common examples of non-reducing sugars include:

1. Sucrose: Common table sugar, which is found in sugarcane, sugar beets, and various fruits, is a disaccharide composed of glucose and fructose units. It is a non-reducing sugar due to the glycosidic bond linking its components.
2. Trehalose: Trehalose is a disaccharide found in some mushrooms, algae, and invertebrates. It is composed of two glucose molecules and is considered a non-reducing sugar.
3. Melibiose: This disaccharide composed of galactose and glucose units is found in legumes such as soybeans and lentils and is classified as a non-reducing sugar.

- **Drops of Benedict's solution is added to the sample and heated. No colour change is observed. Few drops of hydrochloric acid is then added to the mixture and boiled. Sodium hydroxide is added. An orange colour indicates the presence of a complex sugar.**
- **The hydrochloric acid converts the complex sugar into simple sugar.**
- **The sodium hydroxide neutralizes the acid.**

**<u>Test for Proteins</u>**

**Proteins** are food substances made of the elements carbon, hydrogen, oxygen and nitrogen. They form the main structures of the body. The main unit of protein is **amino acid.**

**Essential amino acids** are those which our body cannot manufacture and hence have to be supplied through the diet.

**Non-essential amino acids** are those amino acids which our body can manufacture.

**Sources of Protein**
Meat, fish, eggs, Milk, cheese, curd, soybeans, peas, cereals, nuts and oilseeds like groundnuts, etc.

**Types of proteins**
**1. First class protein.** These are usually found in animals and contain all the essential amino acids necessary for proper growth and development.
**2. Second class proteins**. These are usually of plant origin and lack some of the essential amino acids

**Uses of protein**
1. It the formation of enzymes, hormones, antibodies, hairs.
2. It repairs the body tissues.
3. It the release of energy.
4. It provides material for growth

**Disease due to lack protein in human body**
Kwashiorkor, marasmus, cachexia.

**Test for protein**
**Reagent used to test Protein**
**A. Millon's reagent / mixture of mercury (II) nitrate.**
- Few drops of million's reagent is added to a cloudy/colloidal solution of protein in a test tube.
- The mixture is the heated.
- Formation of **reddish-brown** or **deep red** colour suggests that protein is present.

**B. Biuret reagents / copper (II) sulphate and sodium hydroxide solution.**
Add few drops of Biuret reagent to a clear liquid or colloidal solution of the sample to be tested. Shake thoroughly for few seconds.
A **violet** colour indicates the presence of proteins.
.

**Fats and oils**
They are generally called **lipids**. They exist as fats in the solid state and as oils in the liquid state. They consist of **carbon, hydrogen and oxygen**.

**Functions or Ways by which fats and oils are important to the human body**
- Source of energy
- Fat under the skin of mammals provides insulation against heat loss.
- Fat around organs protects such organs.
- Solvent for fat-soluble vitamins.

**Test for fat and oil**
• **Grease Spot Test**
- Small amount of the food substance containing fat is placed on a filter paper.
- In case of grains and seeds, they are crushed and rubbed on the paper after removing their skin.
- A translucent stain on the paper indicates the presence of fats and oil.

• **Sudan III Test**
- Some amount of Sudan III solution is added to the specimen.
- **Red colour** shows that fat is present.

## STAND 3: SYSTEMS

## Sub-Strand 2: Solar System

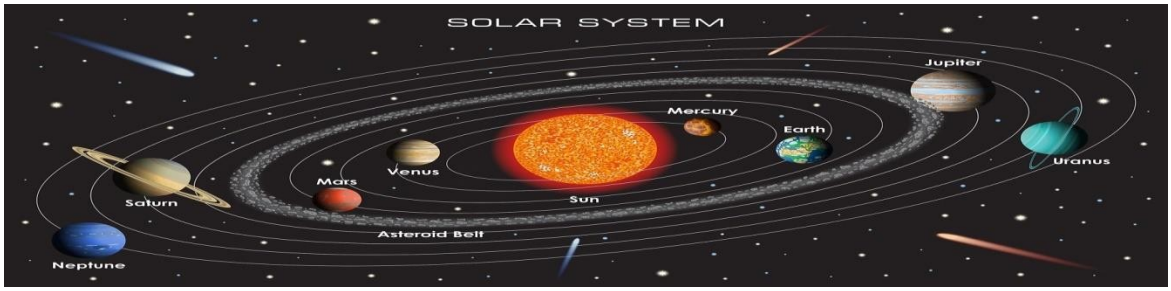
**Content Standard: B7.3.2.1 Know The Inner Planets Of The Solar System And Understand Their Movement In The System.**

**A galaxy** *is a huge collection of stars, planets, gas, dust, and other space stuff held together by gravity.* There are different kinds of galaxies, like spiral galaxies (shaped like a pinwheel), elliptical galaxies (shaped like a football), and irregular galaxies (with no set shape).

| Sl No | Galaxy | Constellation | Origin of name |
|---|---|---|---|
| 1 | Andromeda Galaxy | Andromeda | Andromeda, which is shortened from —Andromeda Galaxyll, gets its name from the area of the sky in which it appears, the constellation of Andromeda. |
| 2 | Antennae Galaxies | Corvus | Appearance is similar to an insect‘s antennae. |
| 3 | Backward Galaxy | Centaurus | It appears to rotate backwards, as the tips of the spiral arms point in the direction of rotation. |
| 4 | Black Eye Galaxy | Coma Berenices | It has a spectacular dark band of absorbing dust in front of the galaxy‘s bright nucleus, giving rise to its nicknames of the —Black Eyell or —Evil Eyell galaxy. |
| 5 | Bode‘s Galaxy | Ursa Major | Named for Johann Elert Bode who discovered this galaxy in 1774. |
| 6 | Cartwheel Galaxy | Sculptor | Its visual appearance is similar to that of a spoked cartwheel. |
| 7 | Cigar Galaxy | Ursa Major | Appears similar in shape to a cigar. |
| 8 | Circinus Galaxy | Circinus | Named after the constellation it is located in (Circinus). |
| 9 | Comet Galaxy | Sculptor | This galaxy is named after its unusual appearance, looking like a comet. |
| 10 | Hoag‘s Object | Serpens Caput | This is named after Art Hoag, who discovered this ring galaxy. |
| 11 | Milky Way | Sagittarius (centre) | The appearance from Earth of the galaxy—a band of light |

**The Milky Way** *is the name of the galaxy where our solar system is located*. It's like our cosmic neighborhood, where we live among billions of stars, planets, and other space objects. The Milky Way is a big spiral galaxy, and it's home to our sun and many other stars.

**An elliptical orbit** *is the movement of one body around another in an oval-shaped path. It can be anywhere from a nearly perfect circle to an elongated oval*.
When we talk about the elliptical shape of the path of movement of the inner planets, we mean that their orbits around the sun are slightly stretched out like ovals. This means that they don't move in perfect circles around the sun. The inner planets (Mercury, Venus, Earth, and Mars) follow these paths as they travel around the sun.
The solar system
**The solar system** *is made up of the sun, the eight planets, the moon, and other heavenly bodies such as comets, asteroids, meteors and meteoroids*. The eight planets revolving around the sun in sequence are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. These planets rotate around the sun in an elliptical orbit/path. There is an asteroid belt between Mars and Jupiter. It serves as a dividing line between the inner rocky planets and other gas giants. We call it the solar system because it is made up of our star, the Sun, and everything bound to it by gravity – the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; dwarf planets Pluto, Ceres, Makemake, Haumea, and Eris – along with hundreds of moons; and millions of asteroids, comets, and meteoroids.



## The Inner Planets

The **inner planets**, or **terrestrial planets**, are the four planets closest to the Sun: Mercury, Venus, Earth, and Mars. **Figure** below shows the relative sizes of these four inner planets.

### ***Mercury***

Mercury is the closest planets to the Sun. The temperature on it is too high to support life. Mercury is the smallest and innermost planet in our solar system. It is named after the Roman messenger god, Mercury, due to its swift orbit around the Sun. Due to its proximity to the Sun and lack of a significant atmosphere to retain heat, Mercury experiences extreme temperature variations. Surface temperatures can reach up to 800 degrees Fahrenheit (430 degrees Celsius) on the side facing the Sun and drop to around -290 degrees Fahrenheit (-180 degrees Celsius) on the side facing away from the Sun.

**Characteristics of the Mercury**

- Closest planet to the Sun
- Smallest planet in our solar system
- Has a thin atmosphere
- Surface is covered in craters
- Has extreme temperature variations
- Slow rotation, taking 59 Earth days for one day on Mercury
- No moons or rings
- Has a magnetic field, although it is much weaker than Earth's.

### ***Venus***

Venus is the second planet from the Sun. It is surrounded by an atmosphere of thick gases that traps heat from the Sun, so it is even hotter than Mercury. The distance between the Sun and Venus is 108 million km. It takes 225 days to orbit the Sun Venus spins slowly in the opposite direction from most planets. Its thick atmosphere traps heat in a runaway greenhouse effect, making it the hottest planet in our solar system with surface temperatures hot enough to melt lead.

**Characteristics of the Venus**

1. Second planet from the Sun
2. Similar in size to Earth
3. Covered in thick clouds of sulfuric acid
4. Hottest planet in our solar system
5. Has a dense atmosphere composed mainly of carbon dioxide
6. No moons or rings
7. Has a retrograde rotation, meaning it rotates in the opposite direction of most other planets

***Earth*** . It is the third planet from the sun. The Earth is planet we live on. The distance from the Sun to the Earth is 150 million km. It takes 365 quarter days to orbit the Sun. It is the only planet that has the ability support/sustain life because of;

1. The presence of oxygen
2. The presence of water
3. Suitable temperature
4. The presence of the ozone layer that protect plants and animals including humans from the harmful ultra-violet rays from the sun.

It is the only known planet to support life with a diverse range of ecosystems. Earth has an atmosphere composed mainly of nitrogen and oxygen, which helps regulate temperature and protect life from harmful radiation. The planet has vast oceans, continents, and diverse landscapes. Earth experiences seasons due to its tilted axis as it orbits the Sun. It is home to a wide variety of plant and animal species, including humans. Earth is constantly changing due to natural processes like plate tectonics, erosion, and weather patterns. Overall, Earth is a unique and precious planet in the universe.

**Characteristics of the Earth**

1. Third planet from the Sun
2. Only known planet to support life
3. Has a diverse range of ecosystems and habitats
4. Covered in approximately 71% water
5. Has a protective atmosphere that allows for the existence of life
6. Has a tilted axis, resulting in seasons

7. Has a moon, which affects tides on Earth

8. Has a variety of geological features, such as mountains, valleys, and plateaus.

***Mars:*** Mars has a reddish, rocky surface and is sometimes called the **red planet**. It is the second smallest planet in the solar system after Mercury. Mars has a diverse range of surface features, including vast deserts, canyons, volcanoes, and polar ice caps. The largest volcano in the solar system, Olympus Mons, is located on Mars. Mars has been a focus of scientific interest due to its potential for supporting microbial life in the past or present. Evidence suggests that liquid water may have existed on its surface in ancient times.

**Characteristics of the Mars**:

1. Reddish appearance
2. Fourth planet from the Sun
3. Thin atmosphere
4. Cold temperatures
5. Dust storms
6. Presence of polar ice caps
7. Volcanic activity
8. Varied terrain with canyons and mountains

**Describe the movement of planets Mercury and Venus around the Sun**

The planets Mercury and Venus both orbit the Sun in a similar way. **They both move in elliptical paths, meaning their orbits are not perfect circles but slightly elongated**. They also both orbit the Sun in the same direction as the Earth, which is counterclockwise when viewed from above the Sun's North Pole. However, the speed at which they orbit differs.

**Mercury**, being the closest planet to the Sun, has a faster orbital speed than Venus. Venus, on the other hand, has a slower orbital speed compared to Mercury. Mercury, being the closest planet to the Sun, has the shortest orbital period of about 88 Earth days. Its orbit is more elongated or elliptical compared to most other planets in our solar system.

**Venus**, on the other hand, has a longer orbital period of about 225 Earth days. Its orbit is also slightly elliptical, but less so than Mercury's. Venus rotates on its axis in the opposite direction to most other planets, a phenomenon known as retrograde rotation.

**Features of the inner planets**

1. All the inner planets are made of rocks.
2. The inner planets do not have rings around them.
3. They do not have moon around them.
4. The inner planets have shorter orbits around the Sun, so they spin very fast.

**Rotation of the Earth**

Earth rotates on its axis from west to east, and the Sun and the Moon appear to move from east to west across the sky. The spinning of the Earth around its axis is called 'rotation'.
The rotation of the earth causes day and night. As the earth is spherical in shape, only one half of it is illuminated by the sun at a time. The other half remains dark.

**Revolution of the earth**

The movement of the earth around the sun is called revolution. The revolution of the earth causes seasons. The revolution of the earth gives the impression that the sun is moving north and south of the equator

**The effects of the rotation of the Earth are:**

1. Day and Night: The rotation of the Earth causes the Sun to appear to rise in the east and set in the west, creating day and night.
2. Changing Shadows: As the Earth rotates, the position of the Sun changes, causing shadows to move throughout the day.
3. Coriolis Effect: The rotation of the Earth affects the movement of air and water, creating winds and ocean currents.
4. Foucault Pendulum: The rotation of the Earth causes a pendulum to swing in a different direction over time, demonstrating the Earth's rotation.

**The differences between revolution and rotation are:**

Rotation: Rotation refers to the spinning of an object around its own axis. In the case of the Earth, it rotates on its axis, which is an imaginary line passing through the North and South Poles. The rotation of the Earth causes day and night **WHILST** Revolution: Revolution refers to the movement of an object around another object. In the case of the Earth, it revolves around the Sun in a slightly elliptical path called an orbit. The revolution of the Earth takes approximately 365.25 days, which is why we have leap years every four years.

## STRAND 3: SYSTEMS

## Sub-Strand 3: Ecosystem

**Content Standard: B7.3.3.1 Recognise the components and their interdependence in an ecosystem and appreciate their interactions.**

**Indicator: B7.3.3.1.1: Analyse the components of ecosystems and identify the interactions within.**

**An ecosystem** is a natural unit, which is made up of living and non-living things interacting together to produce a stable system.

**Basic Ecological terms.**

- **Community .** This is population of different species living in a particular habitat or interacting with each other.
- **Species.** This refers to a group of organisms, capable of interbreeding and producing a fertile offspring.
- **Population.** This refers to a group of organisms of the same species occupying a particular habitat.
- **Ecology .** Ecology refers to the scientific study of the distribution and abundance of organisms.
- **Ecosphere.** This is part of the earth or atmosphere that supports light. Or is the part of the universe habitable by living organism.

**Habitat.** This is a particular place within the environment where organism lives.

**There are two types of habitat. These are**

1. Aquatic habitat (these are organisms that lives on water. E.g. Fish, sea weeds, sharks etc.)
2. Terrestrial habitat (these are organisms that lives on land.

**Advantages of an aquatic habitat**

- The environment is stable. That is, no sudden changes in physical or chemical condition.
- The water provides support for organisms.
- It also provides medium for reproduction.

**Ecological factors**

- Rainfall or water.
- Temperature
- Wind
- Sunlight or light
- Topography
- Drought
- Biotic factors
- Soil ph

**Types of ecosystems.**

There are:

**(a). Aquatic (water) ecosystem**: This is an ecosystem in water bodies.
There are two types of Aquatic ecosystem, namely:

- **Freshwater habitat:** This refers to salt free water as the natural dwelling place of an organism. Examples of salt free water habitats include; rivers, lakes, ponds, and streams. Fish, frog, duck, lotus, and water lily are found in fresh water.

- **Marine water habitat**: This refers to salty water as the natural dwelling place of an organism. Oceans and seas form the largest marine habitat on the planet. Some commonly found organisms are whale, dolphins, sharks, octopus, starfish, jellyfish, seahorse, herrings, tuna, seaweeds

**(b). Terrestrial (land) ecosystems**: This is a land-based community of organisms and the interactions of biotic and abiotic components in a given area.Examples are: tropical rainforest, grasslands, deserts, savanna.Ecosystem can also be classified into natural and artificial ecosystem.

- Natural ecosystem: These are ecosystems which occurs naturally and can survive without any intervention from human beings.Examples are: fresh water, marine, estuarine, lake, rainforest, savanna and desert
- Artificial ecosystem: These are ecosystems which is created by human beings and did not exist naturally.Examples are: farmland, man-made lakes, roads, dams, parks, gardens etc.

**(c) An arboreal ecosystem** is a complex system that includes all the living organisms (plants, animals, and microorganisms) that inhabit and interact within a tree-dwelling environment. These

ecosystems are typically found in forests where trees play a crucial role in providing habitat, food, and shelter for a variety of species.
Here are some animals commonly found in arboreal ecosystems:
1. Monkeys and apes: Primates such as chimpanzees, orangutans, and spider monkeys are well-adapted to life in trees and are often found in arboreal habitats.
2. Birds: Many bird species, including parrots, toucans, and woodpeckers, make their homes in trees and rely on them for nesting and foraging.
3. Sloths: These slow-moving mammals spend most of their lives in trees, feeding on leaves and moving between branches.
4. Tree frogs: These amphibians are known for their ability to climb and live in trees, where they find shelter and breed.
5. Squirrels: Arboreal squirrels are adept climbers and spend much of their time in trees, foraging for nuts and seeds.

## Components of Ecosystem

A). Biotic factors
B). Abiotic factors.

### A. Biotic factors

This is a factor concerned with the way living organisms interact with one another.
**Or Biotic factor** is living organisms in a habitat or environment. The Biotic factor in an Ecosystem are: predation, competition, mutualism, commensalism etc.

### Interactions Between Organisms

**A symbiotic relationship** refers to a close and long-term interaction between two different biological species. In such a relationship, the two species live in close physical proximity to each other and often interact in ways that are beneficial to one or both parties involved. Examples are Mutualism, Parasitism, Commensalism and Predation.

**1. Predation** (parasitism and herbivory): In these interactions, one organism benefits while the other is negatively affected. Red fox and hare interactions is an excellent example of predator-prey dynamics. The hares consume grasses, then the red foxes predate the hares. The grasses are negatively impacted by the hares while the hares benefit by getting a meal. Foxes then benefit by eating the hares.

**2**. **Parasitism** is a relationship in which one organism is helped while the other is harmed. An example is the tape worm. The tape worm obtains its nutrients while residing within the host, while the host is harmed because the tape worm absorbs all of the nutrients.

**3**. **Competition:** Both organisms are negatively affected in some way due to their interactions.

**4. Commensalism**: In this interaction one organism benefits while the other is neither harmed nor gains. Commensalism examples are more difficult as it is hard to prove whether the other animal benefits or is negatively impacted. For example, Remora fish ride other fish and sharks and then eat their leftover food. The sharks and large fish are said not to be affected by the presence of the Remora as they ride them and then eat the leftover food. This interaction would be classed as competitive if Remora fought their hosts for food instead of waiting until they were finished.

**5. Mutualism:** Both organisms benefit from their interactions. Plants with bird or butterfly pollinators are good examples of mutualistic interactions. Plants benefit by having their flowers pollinated so they can reproduce. The butterflies and birds also benefit as they get nectar from the plant. Another example is the ants and the acacia tree which form a symbiotic relationship of mutualism. The ants benefit by living in the acacia tree, and the tree benefits when the ants consume the insects that eat the leaves of the trees.

### Ways in which plants and animals are interdependent

- Plants produce oxygen which is used by animals for respiration.
- Animals give out carbon dioxide which plants use (for photosynthesis).
- Animals depend on plants for food.

### Ways in which biotic factors are useful in an ecosystem or in a forest habitat.

- Birds or insects are agents for pollination.

- Animals are agents of fruits or seed dispersal.
- Trees provide shelter or shade to animals and other plants.
- Bacteria or fungi help to decompose organic matter.
- Control of pest by specific.

**B. Abiotic factor**


**Abiotic factors** are non-living components of an ecosystem that can influence the organisms living within it. Examples of abiotic factors include temperature, sunlight, water availability, soil composition, and air quality.
**Examples are:** climatic (rainfall, humidity, temperature) salinity, altitude, slope of land etc.

**Instruments used to measure abiotic factors.**
1. Temperature - Measured using a thermometer.
2. Light intensity - Measured using a light meter or lux meter.
3. Ph level - Measured using a ph meter or ph test strips.
4. Humidity - Measured using a hygrometer.
5. Soil moisture - Measured using a soil moisture meter or tensiometer.
6. Wind speed - Measured using an anemometer.
7. Atmospheric pressure - Measured using a barometer.
8. Oxygen levels - Measured using an oxygen sensor or dissolved oxygen meter.
9. Salinity - Measured using a salinometer or refractometer.
10. Carbon dioxide levels - Measured using a carbon dioxide sensor or gas analyzer.

**ADAPTATION**
The soil and climatic conditions on land are different in different parts of the earth. It is necessary for organisms to adjust to the conditions and environment they live in. *The special characteristics possessed by plants and animals that enable them to successfully survive in a particular environment is called* ***adaptation.***

***Adaptations of Aquatic Habitats***
**Plants:**
- These plants have long, narrow stems. This prevents the plants from being carried away with the water current.
- Stems have air chambers that allow the aquatic plants to float in water leaves of plants such as lotus and water lily have a waxy coating that prevents them from rotting.

**Animals:**
- Ducks have webbed feet that help them in swimming. They also have hollow bones that help them to stay afloat.
- Gills are special organs that help fish to breath underwater.

- They have streamlined body which allows them to swim fast by reducing resistance due to flowing water.
- Dolphins and whale have blowholes at the upper parts of their heads. They come to the water surface and breathe in air through the blowholes from time to time.

**Adaptation of Forest habitat**

Plants:

The following adaptation is shown by rainforest plants: Leaves of tropical rainforest trees have specialized tips. Due to the dense vegetation of rainforest, very little light is able to reach the forest floor. Plants growing in lower levels have big leaves to absorb as much sunlight as possible.

Animals: There is a huge variety of animals in rain forests. Many animals have adapted by learning to eat a particular food, which is eaten by no other animals.

**Adaptation of Boreal Forests Plants:**

i. Trees have a conical shape that allows the snow to slide off easily.

ii. Trees have needle-like leaves.

This kind of structure protects the leaves from damage.

**Animals:**

I. Many animals migrate to warmer regions during winter. Some animals hibernate during winter months

ii. Some animals have a thick layer of fur or feather to protect them from cold.

**Adaptation of Grasslands Plants:**

i. Grassland plants usually have flexible stems that bend instead of breaking when the wind is strong.

ii. Plants have strong roots that prevent winds from uprooting them.

iii. Plants have narrow or tiny leaves to reduce water loss.

iv. Some plants have roots that extend deep into the soil to absorb as much water as possible.

**Animals:**

I. Most grassland animals are able to run very fast. This ability also protects them grassland fire.

Ii. Many grassland animals have skin shades of brown that makes them hard to spot among the dry, brown grass.

**Adaptation of Deserts habitats Plants:**

I. The leaves are modified as spines to minimize water loss.

Ii. The stem is green, to make food for the plant.

Iii. The stem is swollen and fleshy to store water.

Iv. Cactus plant has a thick, waxy coating that prevents water loss and helps it to retain water.

**Animals:**

I. Desert animals have thick skin to prevent the loss of water from the body

Ii. Most of the desert animals have the capacity to store water and food. For example, a camel can tolerate extremely hot temperature due to the stored water in its body, which helps in cooling. Iii. Most of the small desert animals live in burrows to save themselves from fluctuation in temperature.

Iv. Reptiles are well-suited to the desert climates. They get most of the water through their food and lose hardly any moisture from their skin.

**Adaptation and Acclimatization**

Adaptation refers to change in an organism over a long period of time.

There are certain changes that can occur in an organism over a short period of time, which help the organisms adjust to the changes in its surrounding. This is acclimatization.

**Test your mind**

**1.** Which is the best example of predation in an ecosystem?

A. Bee and flower **b. Fox and rabbit**

C. Flea and rat d. Mosquito and human

**2.** Which represents a positive consequence of competition within an ecosystem?

A. Decreased rate of reproduction

**B. Elimination of inferior organisms**

C. Increased need for natural resources

D. Elimination of entire species of organisms

**3.** Which of these is an abiotic element of a desert ecosystem?

**A. Sand** b. Cactus c. Lizard d. Scorpion

**4.** If krill (small shrimp-like marine fish) is a primary food source for a local population of whales, which will most likely happen to the whales if the krill population suddenly doubles?
A. The whales will have to compete more with each other for available food.
B. The whales will have to find another food source or risk starvation.
C. The whales will migrate to another area.
**D. The whales will increase in number.**

**5**. Which human action would most likely increase the population of cave-nesting animals in an ecosystem?
A. Cutting nesting trees
B. Tracking nesting foxes
**C. Adding nesting boxes**

**6**. Which best describes the effect of human society on a freshwater ecosystem?
A. Movement of minerals and stones due to flowing water in a stream results in a constantly changing water bed.
B. Erosion caused by running water breaking down the river bank changes the geography of the river bed over time.
**C. The discharge of hot water into a freshwater ecosystem results in decreased levels of oxygen available to organisms.**

**7.** A woodland area where deer live is partially cleared to build homes for people. Which best describes how the deer population will change as a result of clearing the land to build homes?
A. The deer population will increase.
**B. The deer population will decrease**.
C. The deer population will remain the same.

**8.** Which is an example of parasitism?
A. Cat and mouse b. Tadpole and frog
**C. Human and tapeworm**

9. The following is a food chain observed in a large wilderness park.
Vegetation → Deer → Cougar
A swarm of insects consumes 70% of the vegetation in the park. As a result, which of the following willmost likely occur?
**A. The prey will decrease in numbers.**
B. The predator will increase in numbers.
C. The prey will be unaffected.
D. The predator will be unaffected.

**11**. Mangrove trees are affected by several factors. Which is an abiotic factor contributing to the energy cycle of a mangrove ecosystem?
A. Bacteria **b. Climate** c. Fungi d. Rocks

**12.** A rainforest area is experiencing a severe drought. As a consequence, the insect population has decreased. What will the insect-eating birds MOST likely do as a result of the drought?
A. Stop searching for food until it begins to rain
B. Begin reproducing to increase population
**C. Move to a new area to find food**
D. Start the process of hibernation

**13.** Which of these organisms is a producer in a marine ecosystem?
A. Fish b. Gull **c. Algae** d. Worm

**14.** Bees visit flowers for their nectar and in the process pick up pollen, allowing flowering plants to cross-pollinate. Which term best describes the relationship between bees and flowers?
**A. Mutualism** b. Parasitism
C. Competition d. Predator-prey

**15**. Acacia trees and acacia ants maintain a mutualistic relationship. Which best explains what would happen to the trees and ant populations if a disease that affects acacia trees is introduced into the ecosystem?
A. Both populations will increase.
**B. Both populations will decrease.**
C. The tree population will decrease, but the ant population will increase.
D. The tree population will decrease, but the ant population will remain the same.

**16.** During science class, William found out that bacteria live in the soil. Which statement BEST describes the function of bacteria and their impact on soil?
**A. Bacteria help increase fertility by decomposing organic matter in the soil.**
B. Bacteria help increase fertility by loosening soil for root growth.

## STRAND 3: SYSTEMS
## Sub-Strand 4: Farming System
**Content Standard: B7.3.4.1 Demonstrate an understanding of the differences among the various farming systems: land rotation, crop rotation, mixed cropping, mixed farming, and organic farming.**
**Indicator: B7.3.4.1.1 Examine and discuss the differences among the various farming systems.**

**Farming system** is used to describe an enterprise which may be entirely animal- based, crop-based or a mixture of the two.
The different types of farming systems practiced in Ghana include:
1. Shifting cultivation
2. Land Rotation
3. Crop Rotation
4. Mixed Cropping
5. Mixed Farming
6. Organic Farming.

**A. Shifting cultivation.** This is a system of farming in which the farmer cultivates a piece of land for some time, the land when it loses its fertility together with his settlement. The farmer may come back to cultivate the old land later.

**Advantages of Shifting cultivation**
1. Land previously used is allowed to fallow so as regain its fertility.
2. Farmer spends little or nothing in improving the soil fertility.
3. The farmer could grow crops on any new land he moves to.

**Disadvantages of Shifting cultivation**
1. Due to increasing population and resultant pressure on land, this system is difficult to practice. 2. The would always have to move or relocate his household.
3. This type of farming system is expensive because of the constant clearing of new land.
4. Erosion can start on abandoned soil.
5. It destroys the natural forest 6. Yield is very low because farm inputs which improve yields are not used.

**B. Land rotation**.
This is a system of farming in which a farmer cultivates a piece of land for some time and leaves it to clear a new land when the old land becomes less fertile. The farmer moves to the new land without moving his settlement.

**Advantages of Land rotation**
1. The land regains its fertility after the fallow period.
2. Disease build up is reduced.
3. Pest attack is reduced.

**Disadvantages of land rotation**
- It destroys the virgin forest.
- Land rotation cannot be practiced in areas where the land is scarce.
- Commercial production is discouraged.

**C. Crop rotation** is the practice of growing a series of dissimilar or different types of crops in the same area in sequenced seasons.

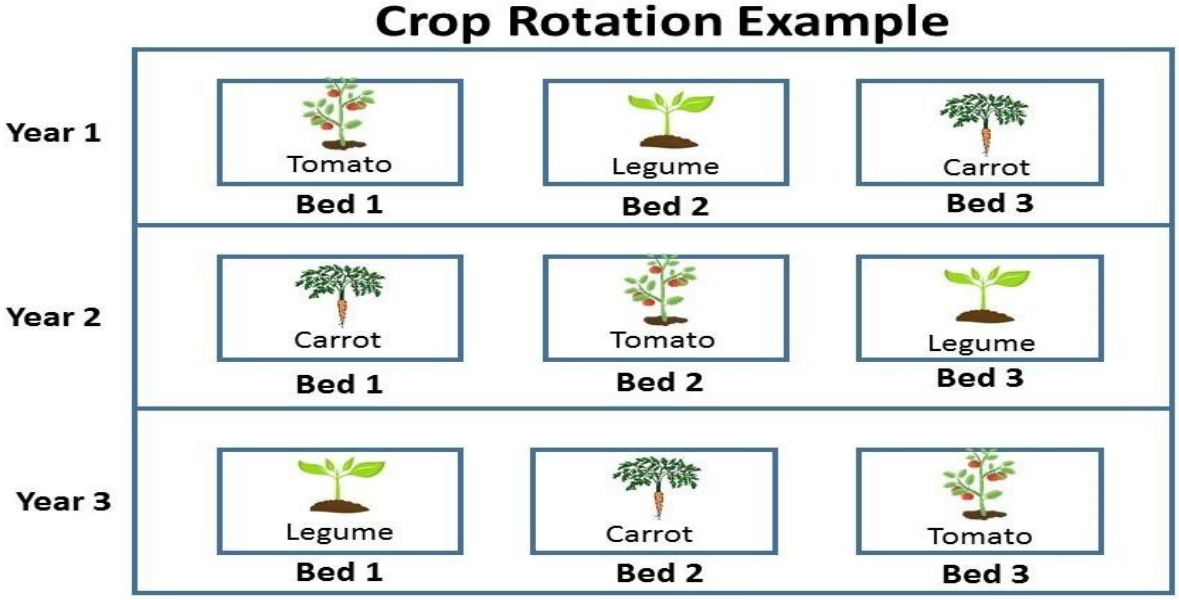
**Principles of crop rotation**
- Crops with deep roots should be followed by crops with shallow roots.
- Crops which use much more nutrients should be followed by crops that use less nutrients.
- Crops that come from the same family, e.g. Rice and maize, must not follow one another.
- Legumes should be included in the rotation plan.

**Reasons why legumes are included in crop rotation**

- Legumes improve the structure of the soil.
- Legumes add nitrogen to the soil thereby improving soil fertility.
- They control soil erosion when used as cover crops. E.g. Cowpea.
- There is reduction in labour use, e.g. No frequent land clearing.

**Reasons why it is important for farmers to keep records during crop production**

- Records show how much tax to pay.
- Helps the farmer to plan or budget for the future or making management decisions.
- Helps to know total investment made into the farm business.
- It helps the farmer to obtain loans to determine the amount of yield or productivity made.
- To measure progress in crop production.
- For educating new generation of farmers.




**Advantages of crop rotation**

1. There is reduction of total crop failure
2. Soil fertility is maintained because of the inclusion of leguminous plants
3. Crop rotation controls soil erosion.
4. It breaks pest cycle
5. It breaks disease cycle 6. It ensures effective use of labour.

**Disadvantages of crop rotation**

1. Special skill is required in carrying out this type of farming system.
2. Cultural practices are difficult to carry out on the same piece of land because different crops are involved.

**D. Mixed cropping, also known as inter-cropping or co-cultivation,** is a type of farming that involves planting two or more of plants(crops) simultaneously in the same field.

**Advantages of mixed cropping**

1. Different crops may be harvested at different times. This helps the farmer to get food over a long period.
2. Since different crops are grown, pests and diseases may not spread easily.
3. Where cover crops or legumes are grown, they soil fertility.

**Disadvantages of mixed cropping.**

1. The crops may compete for nutrients, water, light and space for survival.
2. Different fertilizers may be needed in some cases, for different crops. This could increase the cost of production.
3. Mechanization is difficult.
4. Improper spacing may lead to shading of other crops.

**E**. **Mixed farming** is the cultivation of crops along with rearing of animals for meat or milk on the same farm at same time.

**Advantages of mixed farming.**

1. The is regular supply of food for the farmer and his family.
2. The fertility of the soil is improved by the use of farm yard manure.
3. There is no need for the farmer to shift to a new piece of land since there is less likelihood of low soil fertility.
4. Plant matter may be used to feed animals while animal dung or droppings may also be used to fertilize crops field. This reduces the cost of production since less feed is purchased for animals while the soil is also fertilized with manure from animals.

**Disadvantages of mixed farming.**

1. The farmer may have divided attention for keeping both crops and animals.
2. It requires a lot of skills in managing crops and animals.
3. Animals usually destroy crops when they are not well confined.

**F. Organic farming** is defined as production of crop, animal, and other products without the use of synthetic chemical fertilizers and pesticides, transgenic species, or antibiotics and growth enhancing steroids, or other chemicals.

**Advantages of organic farming**.

- Organic produce attracts high price in foreign markets.
- Food produced are free from harmful chemicals.
- Organic farming is labour intensive.
- Organic farming cannot be used to produce food on large scale.

**G. Ecological farming,** also known as eco-friendly or sustainable farming, is an approach to agriculture that focuses on promoting biodiversity, preserving natural resources, and minimizing the use of synthetic inputs. It aims to produce food in a way that is **environmentally friendly** and socially responsible. Ecological farming practices often include crop rotation, organic fertilizers, agroforestry, integrated pest management, and the use of natural predators to control pests.

**Indicator: B7.3.4.1.3 Importance of farming systems**

**Importance of farming systems**

i. Farming system serves as a source of lively-hood.
ii. It provides employment opportunities.
iii. It contributes to the development of the economy.
iv. It provides industries with raw materials to the such cocoa, rubber, cotton, tobacco, etc.

## STRAND 4: FORCES AND ENERGY

### Sub-Strand 1: Energy

**Content Standard: B7.4.1.1: Demonstrate an understanding of forms of energy and their daily applications.**

**Indicator: B7.4.1.1.1 Identify the various forms of energy and show how they are related.**

**Energy** is the ability or capacity to do work. It is measured in joules (J). The following are some forms of energy:

I. Mechanical energy (potential and kinetic energy
Ii. Chemical energy
Iii. Light energy
Iv. Sound energy
V. Nuclear energy
Vi. Electrical energy
Vii. Thermal energy
Viii. Solar energy

**Mechanical Energy**: It is the energy that a body has due to its position or its states of motion. There are two forms of mechanical energy: These are potential and kinetic energy. Mechanical energy = kinetic energy (KE.) + potential energy (PE.) **Mechanical energy** is the sum of potential and kinetic energy. **Example:** objects have mechanical energy if they are in motion or if they are at some position relative to the surface.

**Forms of Energy**

1. **Potential Energy**

Potential energy is the energy possessed by a body by virtue of its position. Or Potential energy is the energy a body has as a result of its position or state of rest. Potential energy: Potential energy (PE) is calculated by using the formula mass (m) x acceleration due to gravity(g) x height (h) of the object.
**Potential energy cannot be transformed directly into heat energy.**
**Examples of potential energy**

- Water stored up behind a dam.
- A stretched elastic band.
- A stationary car.
- Mango hanging on a tree.

**Factors that affect potential energy:**

1. Objects of larger masses have greater potential energy than objects of smaller masses
2. The higher the acceleration due to gravity, the greater the potential energy and vice versa.
3. The higher the height of an object, the greater the potential energy and vice versa.

1. A body of mass 14.0 kg is placed on an orange tree 17.0m above the ground. Calculate its potential energy with respect to the ground. [g = 10m/s2].
**Answers:** Given that; mass of the of object, (m) = 14kg, height (h) of the tree = 17m acceleration due to gravity, g = 10m/s2
Potential energy ((P.E) = m x g x h
= 14kg x 10m/s2 x 17m
= 2380J

2. The potential energy of a body 5 m above the ground is 200 J. Calculate the mass of the body if g = 10 m/s2. **ANSWER**: Potential energy (P.E) = 200J height (h) = 5m g= 10m/s2 mass(m) =?
Mass(m) = P.E / g x h
= 200/ 10 x 5
= 200/ 50 = 4kg
The mass of the body = 4kg.

3.Three objects X, Y and Z with masses 30 kg, 55 kg and 27 kg respectively are placed on top of a building of height 35 m from the ground. State with reasons, which of the objects:
Has the least potential energy?
Has the greatest potential energy?
Will have the greatest kinetic energy when rolled to fall?
**Answers:** Mass of object X, m (X) =30kg, mass of object Y, m(Y) = 55kg, mass of object Z, m(Z) = 27kg The height of all the three objects from the ground (h) =35m.
Object Z has the least potential energy because it has the least mass. The smaller the mass of an object the smaller its potential energy.

Potential energy for Z = 27kg x 10m/s2 x 35m = 9,450J 51
Object Y has the greatest potential energy because it has the greatest mass. The greater the mass of an object the greater its potential energy.
Potential energy for Y = 55kg x 10m/s2 x 35m = 19,250J
Object Y will have the greatest kinetic energy when rolled because it has the greatest mass. The greater the mass of an object the greater the kinetic energy and vice versa.

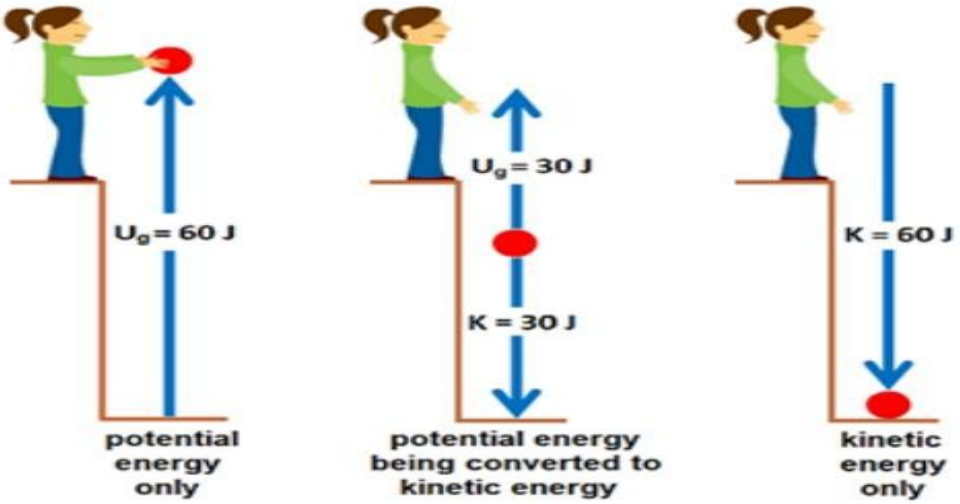
## 2. Kinetic Energy

Kinetic energy is the energy possessed by a body by virtue of its motion. Or Kinetic energy is the energy a body has as a result of its motion or speed. . It is calculated by using the formula,
$(K.E) = ½ \times mv^2$
1. The mass of a bicycle is 10 kg, and it moves at a constant velocity of 10 m/s. Find out the kinetic energy of this bicycle?
$KE = 1/2\ mv^2$
KE= 1/2 (10 kg) (10m/s)
KE = 50 Joules

**Factors that affect kinetic energy**:
1. The greater the mass of an object the greater the kinetic energy and vice versa.
2. The higher the velocity of the object, the greater the kinetic energy and vice versa.


**Examples of kinetic energy**

- A moving vehicle.
- A ball rolling on the ground.
- A flying bird.
- An athlete running a hundred metre race.



3. **Sound energy**

Vibrating objects emit sound energy. **Examples:**

- An air conditioning fun
- An airplane taking off

**Microphone** is a device that converts sound energy into electrical energy.

4. **Heat or thermal energy**

**Heat** is the amount of energy which tells the amount of thermal energy contained in a body. Or **Heat** is a form of energy transfer from a higher temperature object to a lower temperature object. **Example of heat energy** Hot materials e.g. Hot water, steam, naked fire, heated metal, red hot charcoal.

5. **Chemical energy**

Chemical energy is energy stored in the chemical bonds between atoms.

**Examples:**

- Dry cell or batteries
- The chemicals in fuels and in foods.

6. **Electrical energy**

Electric energy *is the energy in an electric current.*

**Example:** Electric current

7. **Nuclear energy**

**Nuclear energy** is energy that is stored and released in the nucleus of an atom.

**Example:**

- All atoms contain nuclear energy. E.g. Nuclear energy of radioactive atoms, energy in bombs.

8. **Solar energy**

**Solar energy** is the energy emitted from the sun.

**Examples:**

- Solar water heating
- Solar cells
- Solar lighting

9. **Gravitational potential energy** *is the energy possessed by an object due to its position in a gravitational field.* It is the potential energy that an object has based on its height above a reference point. The higher an object is above the reference point, the greater its gravitational potential energy. This energy can be converted into other forms, such as kinetic energy, when the object falls or moves downward in the gravitational field. GPE = mgh

**Applications/ Uses Of Light Energy**

Light energy is a source of electromagnetic radiation that is visible to the human eye. However, there are several industrial and science applications of light energy, some of them are:

**1. Food:** Light is the only source of food generation for all living thigs. Every organism depends on light for their energy and food except for few chemotrophic species such as bacteria.

**2. Vision:** Many living organisms are able to see things around them due to the presence of the eye, which could be useless without light. Our eyes create an image as light falls on them and this information goes to the brain. This light energy helps us to see things around us.

**3. Health:** The sunlight also provides vitamin D which help in increasing bone strength.

**4. Colours**: The world is so colourful and all these colours are possible because of the sunlight. The light consists of several spectra, and each spectrum has a specific colour. That is ROYGBIV-Red, Orange, Yellow, Green, Blue, Indigo and Violet.

**5. Electronics**: Solar panels use the sunlight to store light energy and convert it into electrical energy. This electrical energy is applicable for domestic purposes as it eco-friendly and cost - effective.

**Content Standard: B7.4.1.2 Demonstrate an understanding of the concept of heat transfer and its applications in life.**

**Indicator: B7.4.1.2.1: Explain and demonstrate how heat is transferred in various media.**

## Heat transfer

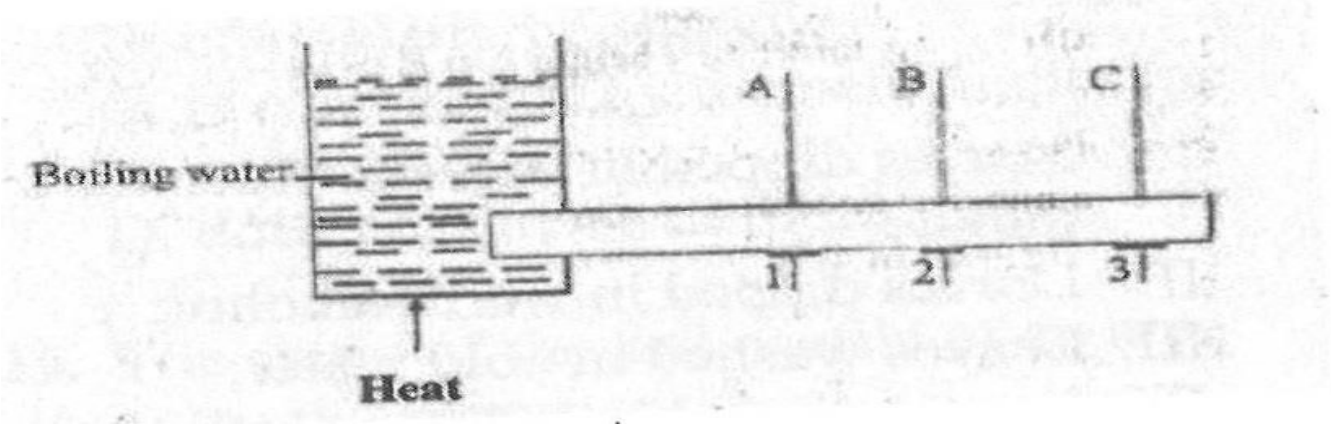
### The modes of heat transfer

Heat travels from a hot object to a cold object. The transfer of heat from one place/body to another can be achieved through three main ways;


1. **Conduction** **2.Convection** **3. Radiation**

**1. Conduction** It occurs when energy is transferred through an object due to the movement of particle due to contact. The energy that is transferred is in the form of heat or electricity

Conduction is the transfer of energy through matter from particle to particle. It is the transfer and distribution of heat energy from atom to atom within a substance. Conduction takes place mainly in solids. It also takes place in liquids and gases but not very efficient since other methods of the energy flows in liquids and gases are more important.




**I. Aim of the experiment**

To show that heat (energy) is transferred through metals/solids by conduction

Ii) **Temperature of boiling water**

100$^{o}$c

Iii) The pins fall off as the wax melt.

Iv) **A** will have the highest temperature followed by **B** and **C** is the least (Temperature A > Temperature B > Temperature C)

V) **How heat is transmitted from the sun to earth**

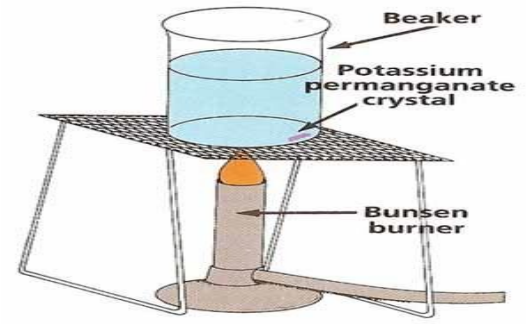
Heat is transmitted from the sun to the earth through **radiation**

**2. Convection.** Convection is the transfer of heat energy through fluids (liquids and gases)**.**

Convection in fluid is the transfer of heat energy by the circulation of a fluid as a result of temperature differences within the fluid. **OR**

Convection is the displacement of hot molecules of a fluid by colder ones in a continuous motion.

Convection usually takes place in liquids and gases (fluids) but not in solids. Liquids and gases do not conduct heat very well, but they can be transfer heat by convection




**Experiment to show how a crystal of potassium permanganate is used to demonstrate convection**

- A crystal of potassium permanganate is introduced to the bottom of a beaker of water.
- The beaker of water is heated gently.
- As water warms up at the bottom it expands.
- The heated molecules at the bottom move upwards and are then replaced by colder and heavier ones above.
- A current of coloured water is seen moving throughout the water.
-

**Convectional current** This is the flow of heat of energy in fluids involving the mass motion of the fluid molecules.

**How smoke from burning bush is spread by moving air masses**

The smoke from burning bush contains warmer air masses, which is less dense than the following air masses which is denser and cooler. Hence warmer air from the smoke rises and cooler air moves in to take its place. As a result of convectional current, the smoke spread to other areas by moving air masses.

**Reasons why convection cannot take place in solids**

*Particles in solids occupy fixed positions or do not move from one point to another*. They only vibrate about a mean position. They are therefore incapable of carrying heat from one point to another.

**Reasons why water boils at the top of test tube while the bottom remains cold**

- Water is a bad conductor of heat
- Only molecules at the top get heated.
- The heated molecules become lighter and are not able to move downward to displace the heavier molecules.
- Heat is not able to be transferred from the top to the bottom.
- Hence continues heating causes the top to boil while the bottom remains cold.

**Practical applications of convection currents**

- ✓ **Ventilators.** Rooms are provided with ventilators near top of sidewalls.
- ✓ **Chimney.** Chimney are fitted in factories to remove undesirable fumes and smoke.
- ✓ **Room heaters.** It is advisable to place the room heaters at the ground level for effective heating.
- ✓ **Freezer.** In a refrigerator, the freezer is always situated at the top. The cold air around the freezer sinks down to cool the things kept at the lower part of the refrigerator.
- ✓ **Car radiators.** When a car engine runs for a long time, it gets heated. To prevent overheating, it is surrounded by a cooling system called a radiator.

**3. Radiation** is the transfer of heat energy from one place to another by means of electromagnetic radiation. Waves of the electromagnetic spectrum have the ability to transfer heat energy this way. By radiation, thermal energy from the sun is transferred to the earth.

**Why a body holding long metal rod in fire feels a burning sensation?**

- A metal rod is a good conductor of heat.
- Hence the heat travel from one end of the metal in the fire to the opposite end.
- Nerves sensitive to heat in the palm/skin are stimulated and the heat is felt in the palm.

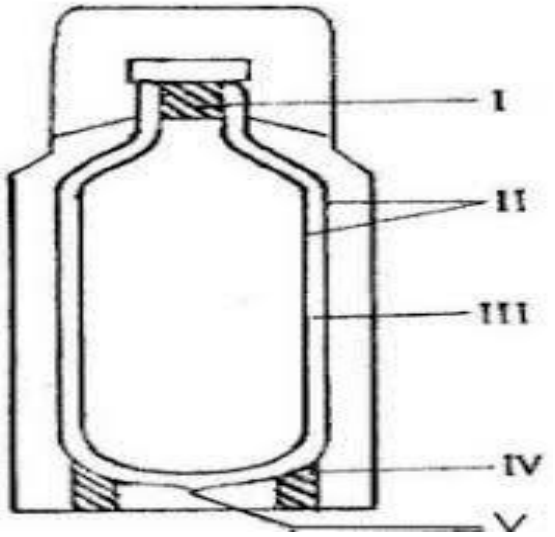
**Applications of conduction, convection and radiation in the thermos vacuum flask**

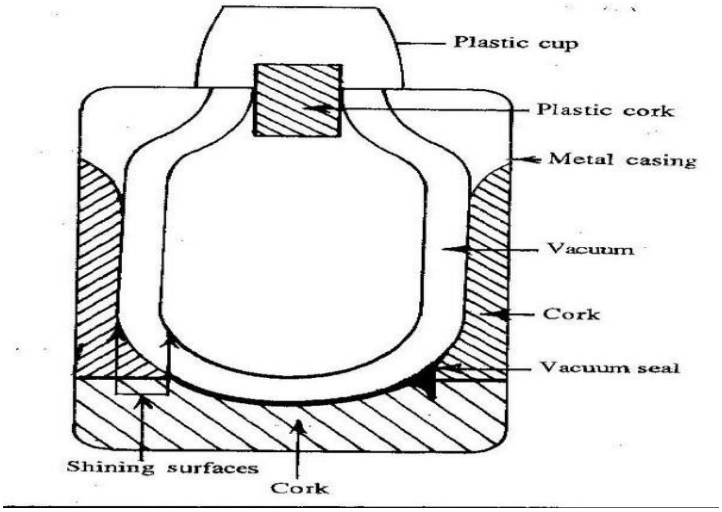
**Vacuum flask**

Vacuum flask is a device for keeping liquids warm (or cold) in colder or warmer surroundings. It works by reducing all three modes of heat transfer. The flask consists of an insulated outer container containing the inner vacuum flask, which essentially consists of a double walled glass vessel, with an evacuated space between the walls. This reduces conduction through the vessel wall. The inner walls of the flask are coated with a thin layer of silver, acting as a mirror which reflects heat, thus reducing losses by radiation. The stopper reduces losses by convection.

**How heat gain and heat loss are minimized by the vacuum flask**

- The cork support and cork lid prevent heat losses by conduction.
- Heat loss by conduction is also prevented by vacuum within the double wall of the flask.
- The vacuum between the double wall of the flask prevent heat loss by convection.
- The smooth shiny surfaces of the flask reflect back the heat that would have been lost through
- Radiation.




1. Parts I - Cork or plastic/rubber stopper
II - Silvered or shiny surfaced double wall
III - Vacuum or empty space
IV - Cork support or plastic/rubber support
V - Vacuum seal

**2. How the device minimizes heat loss or gain through**

**($\alpha$) conduction**-Minimized by the cork or plastic/rubber stopper and Cork support or plastic/rubber support

**($\beta$) convection-**Minimized by the vacuum

**($\gamma$) radiation**-Minimized by the silvered or shiny surfaced double wall

**Differences between convection and radiation of heat**

| Convection | Radiation |
|---|---|
| It involves the movement of molecules | No molecules are involved |
| It cannot occur across a vacuum | It occurs across a vacuum |
| It occurs in fluids (liquid and gas) only | It does not need any material medium. |

## B7.4.1.3.1 Demonstrate how light travels in a straight line

### LIGHT ENERGY

**Light** is a form of electromagnetic spectrum and travels at the speed of 3.0 .

**Properties of light**

- It can be refracted
- It can be reflected
- It can be diffracted
- It can be interfered

.

**Sources of Light**

- Moon
- Sun
- Star
- Fire flies
- Electric bulbs
- Television set

**Natural sources of light**

- ✓ Sun
- ✓ Stars
- ✓ Fireflies

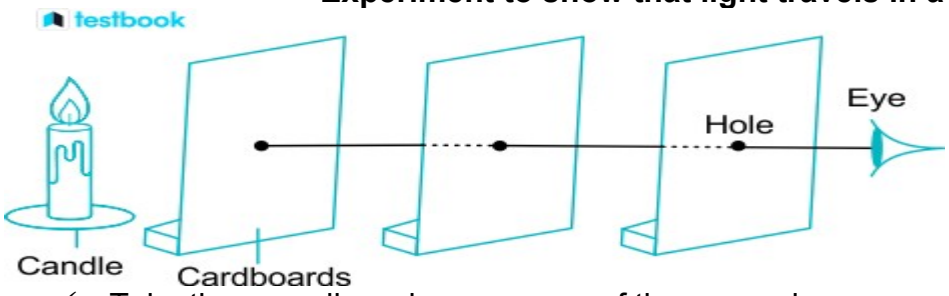
**Artificial sources of light**

- ✓ Candle light
- ✓ Electric bulb
- ✓ Hurricane lamp

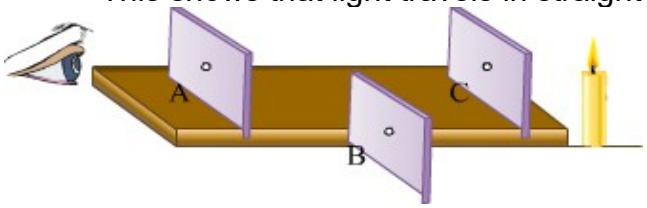
### Rectilinear propagation of light

This refers to the idea that light travels in the straight line without any interference.

**Experiment to show that light travels in a straight line**

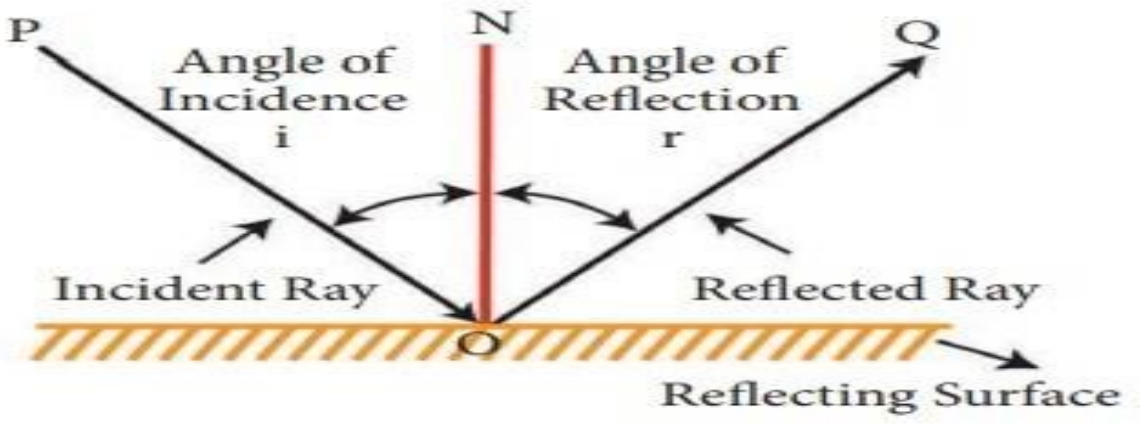



- ✓ Take three cardboards or screens of the same size.
- ✓ Make small holes in their centres at exactly the same height.
- ✓ Place or set them up so that the holes are in a straight line by threading a sting through the holes and pulling it taut.
- ✓ Place a lamp or a lighted candle at one end of the arranged screens.
- ✓ The light can be seen through the three holes by an eye or observer viewing at the other end of the light source.
- ✓ Move one of the screens so that the holes are no longer in a straight line.
- ✓ It would be observed that light can no longer be seen (light cut off).
- ✓ This shows that light travels in straight lines.




### Reflection of light

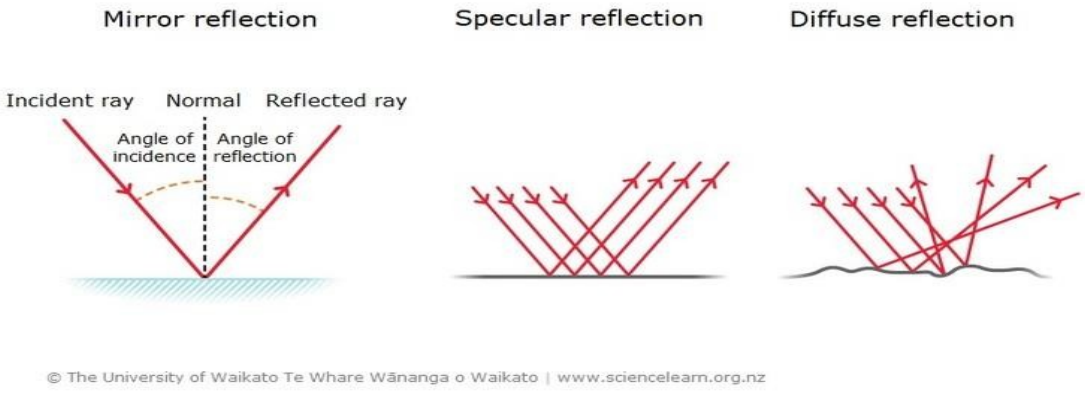
Reflection of light is the bouncing back off light by an object. Shiny surfaces (mirrors) or highly polished surfaces are good reflectors.




**Types of reflection of light**

1. **Regular/specular reflection.** This occurs when the surface of reflection is smooth or highly polished. The image produced is clear or well defined. Example is a mirror. It obeys the laws of reflection.

2. **Irregular/rough/diffuse reflection.** It occurs when the surface of reflection is rough. Image formed is not well defined.




**Laws of reflection**

1. The incident ray, the reflected ray and the normal at the point of incidence all lies in the same plane.
2. The angle of incidence is equal to the angle of reflection.

**Why light bends when it moves from air into water**

- ✓ Air is less dense than water
- ✓ The velocity of light in air is greater than the velocity of light in water.
- ✓ Thus, any ray passing from air into water will bend towards the normal in water.
- ✓ Thus, the ray bends away from its original path.

**Dispersion of light**

**Dispersion of light** *is the separation of white light into its component colours by refracting medium*.

Natural phenomenon that involves **dispersion** of light i**s rainbow**. The dispersion medium for rainbow is **water droplets or water.**

White light is simply the light from the sun, stars, torchlight, and electric lamps. White light is made up of seven colours namely; red, orange, yellow, green, blue, indigo, and violet (ROYGBIV).

These different colours forming white light can be seen in a rainbow or when a white light passes through a prism (a triangular block of glass or plastic).

Dispersion of light occurs when light passes through a medium, such as a prism or water droplets, and is separated into its component colors.

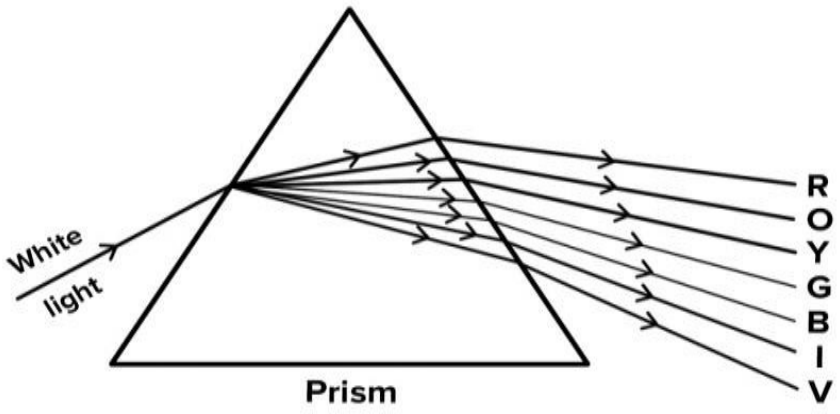
*This happens because different colors of light travel at different speeds when they move from one medium to another, causing them to bend or refract by different amounts.*

When white light, which is a combination of all the colors of the visible spectrum, enters a medium like a prism, the different colors within the light are bent by varying amounts due to their different wavelengths. This causes the white light to spread out into its individual colors, creating a spectrum of colors, such as those seen in a rainbow.

This process is also responsible for phenomena like the separation of colors in a rainbow after rain, or the beautiful display of colors when light passes through a prism. Dispersion of light is an important concept in understanding how we perceive and study the properties of light and color.

**Experiment to demonstrate dispersion of light using triangular prism**.

Materials needed: Triangular prism, an arrow beam of light, a screen Procedure:
1. Set up the experiment as shown in the diagram below.
2. Switch on your light source
3. Regulate the position of the light source until a clear and sharp image of the components of light is seen on the screen.




Dispersion of white light

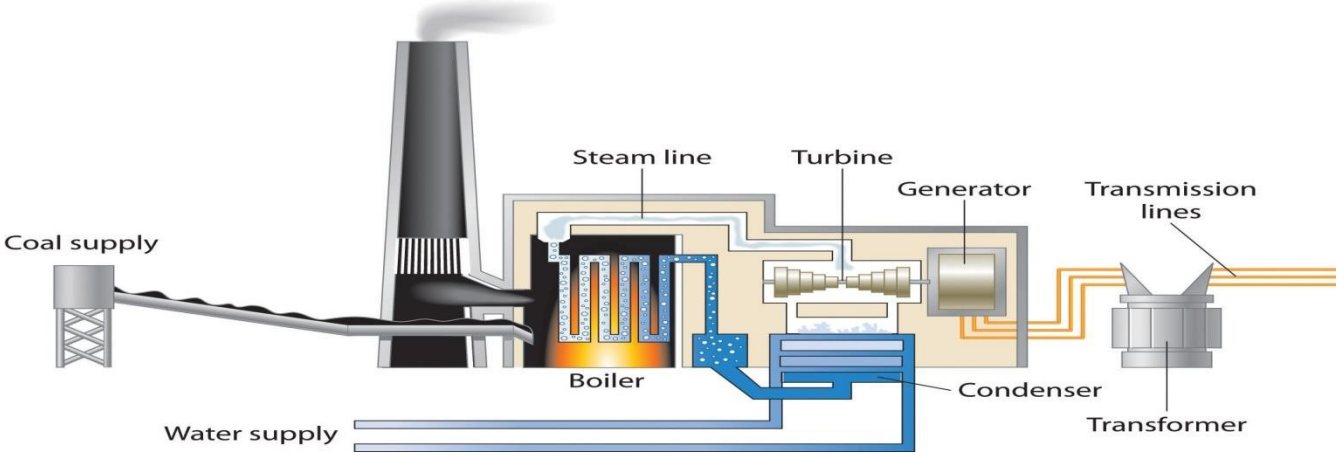
Observation: All the components of white colours are seen on the screen as shown below.
Conclusion: Dispersion of white light has occurred.

**STRAND 4: FORCES AND ENERGY**
**SUB-STRAND 2: ELECTRICITY AND ELECTRONICS**
**B7.4.2.1.1 Describe the various forms of electricity *generation***

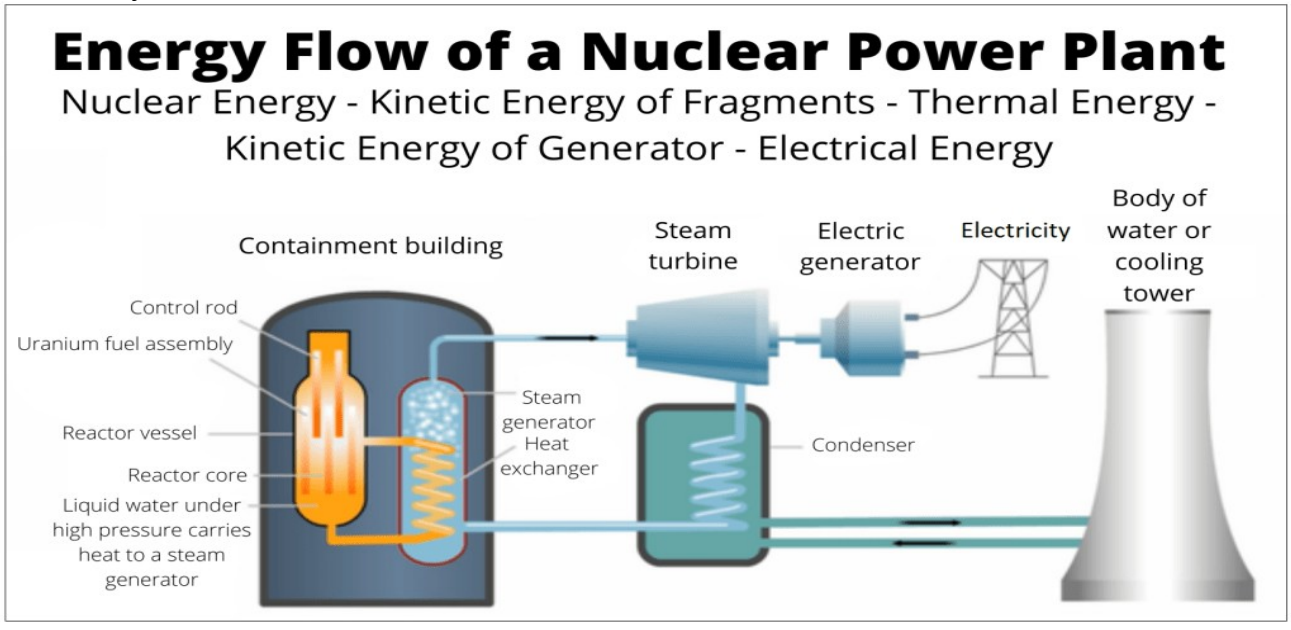
## Electricity generation

**Electricity generation** is the process of producing electrical energy from other forms of energy, such as coal, natural gas, nuclear, or renewable sources like wind and solar.
There are several forms of electricity generation. Some of the most common ones include:

**1. Fossil Fuels**: This traditional form of energy generation involves burning coal, natural gas, or oil to produce heat, which is used to generate steam and drive turbines that produce electricity. Fossil fuel power plants have been a major source of electricity for many years, but they are associated with environmental concerns such as air pollution and greenhouse gas emissions.



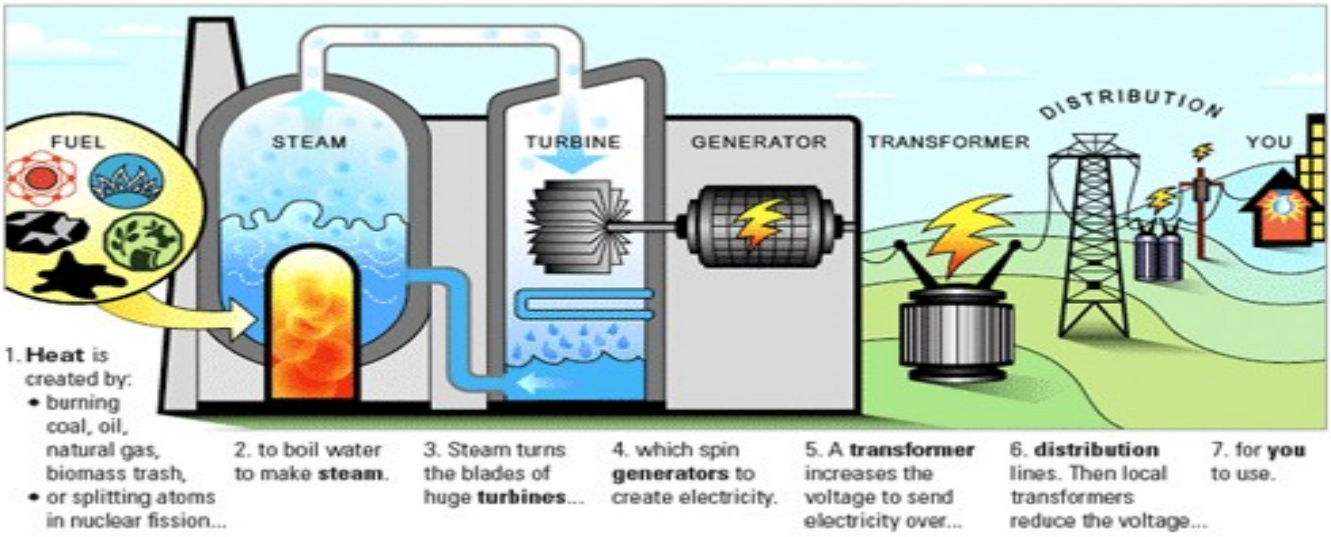

**2. Nuclear Energy:** Nuclear power plants generate electricity through nuclear fission, where the nucleus of an atom is split, releasing a tremendous amount of energy. This energy is used to heat water and produce steam, which drives turbines to generate electricity. Nuclear energy is a low-carbon source of power but comes with its own set of challenges, including radioactive waste disposal and safety concerns.



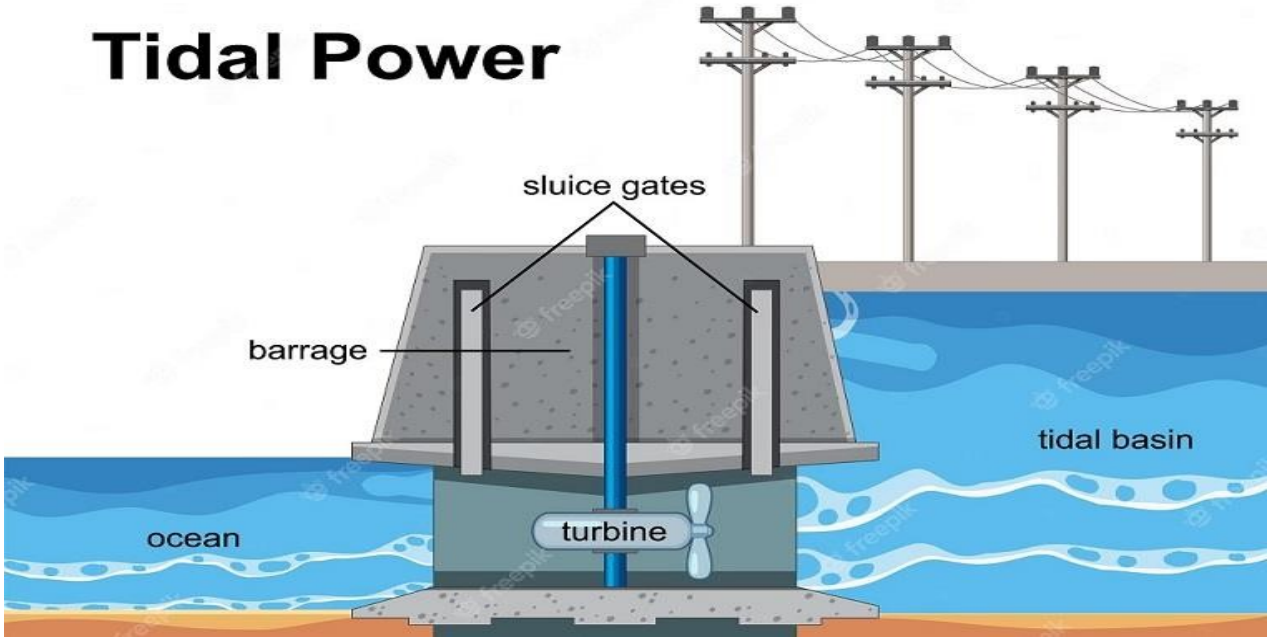

**3. Renewable Energy:** This category includes various forms of energy generation that harness naturally replenishing resources such as sunlight, wind, water, and geothermal heat. Examples of renewable energy sources include solar photovoltaic panels for solar power, wind turbines for wind power, hydroelectric dams for hydroelectric power, and geothermal power plants for geothermal

energy. Renewable energy technologies are considered more sustainable and environmentally friendly compared to traditional fossil fuel-based methods.

**4. Biomass Energy:** Biomass energy generation involves using organic materials such as wood, agricultural residues, and biofuels to produce heat or electricity through processes like combustion or anaerobic digestion. Biomass can be a renewable and carbon-neutral energy source when managed sustainably.




5. **Tidal Power:** Tidal power plants harness the energy from the rise and fall of ocean tides to generate electricity.




**<u>The nature and generation of thermal and nuclear electricity</u>**

**Thermal electricity generation** involves the use of heat to produce electricity. This can be done through the burning of fossil fuels such as coal, oil, or natural gas. The heat generated from the combustion process is used to produce steam, which then drives a turbine connected to a generator.

The generator converts the mechanical energy from the turbine into electrical energy.
Nuclear electricity generation, on the other hand, involves the use of nuclear reactors. These reactors use a process called nuclear fission, where the nucleus of an atom is split into two smaller nuclei,

releasing a large amount of heat energy. This heat is then used to produce steam, which drives a turbine connected to a generator, similar to thermal electricity generation.

**Differences between the nature and generation of thermal and nuclear electricity**
The main difference between thermal and nuclear electricity generation is the source of heat.

***In thermal generaion, the heat is produced by burning fossil fuels, while in nuclear generation, it is produced through nuclear fission.***
It's important to note that while both thermal and nuclear electricity generation have been widely used, there are concerns about their environmental impact. Thermal generation contributes to air pollution and greenhouse gas emissions, while nuclear generation produces radioactive waste that needs to be carefully managed.

**Electricity generation has both positive and negative impacts on the environment. Here are some of the impacts:**

**Negative impact in the environment**
1. Air Pollution: The burning of fossil fuels, such as coal and natural gas, in power plants releases pollutants like sulfur dioxide, nitrogen oxides, and particulate matter. These pollutants contribute to air pollution and can have detrimental effects on human health and the environment.
2. Greenhouse Gas Emissions: Fossil fuel-based power plants are major contributors to greenhouse gas emissions, particularly carbon dioxide (CO2). These emissions are a significant driver of climate change and global warming.
3.Water Consumption: Many electricity generation methods require large amounts of water for cooling purposes. This can lead to water scarcity and negatively impact aquatic ecosystems.
4. Land Use: Certain types of power plants, such as solar farms and wind turbines, require significant land area for installation. This can result in habitat destruction and fragmentation, affecting local wildlife.

**Positive impacts of electricity generation on the environment**:
These positive impacts highlight the potential for electricity generation to contribute to a more sustainable and environmentally friendly future.
1. Renewable Energy Sources: The use of renewable energy sources like solar, wind, and hydroelectric power can significantly reduce greenhouse gas emissions and air pollution. These sources are sustainable and do not deplete natural resources.
2. Energy Efficiency: Electricity generation technologies are becoming more efficient, resulting in reduced energy waste. Energy-efficient appliances and buildings also contribute to lower electricity consumption and a smaller environmental footprint.
3. Environmental Conservation: The availability of electricity enables the implementation of environmental conservation measures. For example, electric vehicles help reduce air pollution and dependence on fossil fuels, while electric heating systems can be more efficient and cleaner than traditional heating methods.

**How to reduce  the negative impact of electricity generation**
To reduce the negative impact of electricity generation, there are several strategies that can be implemented:
1. Increase energy efficiency: Encouraging the use of energy-efficient appliances and technologies can help reduce the overall electricity demand, thereby decreasing the negative impact of electricity generation.
2. Transition to renewable energy sources: Shifting towards renewable energy sources such as solar, wind, hydro, or geothermal power can significantly reduce the environmental impact associated with electricity generation. These sources produce clean energy and have lower carbon emissions compared to fossil fuel-based power plants.

3. Implement carbon capture and storage (CCS) technologies: CCS technologies can capture and store carbon dioxide emissions from power plants, preventing them from being released into the atmosphere. This can help mitigate the negative impact of electricity generation on climate change.
4. Promote energy conservation: Encouraging individuals and businesses to conserve energy through practices like turning off lights when not in use, using natural lighting, and optimizing heating and cooling systems can help reduce the overall electricity demand and its associated negative impacts.
5. Improve grid infrastructure: Upgrading and modernizing the electricity grid can help minimize transmission losses and improve overall efficiency, reducing the negative impact of electricity generation.

**Content Standard: B7.4.2.2 Demonstrate knowledge of how to assemble and explain the functions of basic electronic components and their interdependence in an electronic circuit.**

**Electronic components**

**Electronic components** *are the individual parts and devices that make up electronic circuits and systems.* These include

**1. Resistors:** Resistors limit the flow of electrical current in a circuit, control voltage levels, and protect components from excessive current.

**2. Cell:** A cell is a single unit that converts chemical energy into electrical energy, providing power to electronic devices.

**3. Battery:** A battery is a collection of cells connected together to store and provide electrical energy for electronic devices.

**4. Connecting wires**: Connecting wires establish physical connections between electronic components, allowing the flow of electrical current and signals within a circuit.

**5. Capacitors:** Capacitors store and release electrical energy, filter out noise or unwanted signals, and stabilize voltage levels in electronic circuits.

**6. Transistors:** Transistors amplify or switch electronic signals, serving as fundamental building blocks in electronic circuits for tasks such as amplification, switching, and signal processing.

**7. Bulb:** A bulb (incandescent or LED) converts electrical energy into light energy when current passes through it.

**8. P-N junction diode :** A P-N junction is the interface between a semiconductor's P-type material (with an excess of positive charge carriers) and N-type material (with an excess of negative charge carriers), forming the basis of diodes and transistors. It allows current flow in one direction.

**9. LED (Light-Emitting Diode):** An LED is a semiconductor light source that emits light when an electric current passes through it, commonly used in indicators, displays, and lighting applications.

**10. Key (Switch):** A key or switch controls the flow of current in a circuit by opening or closing the circuit path.

**11. Ammeter**: An ammeter measures the electric current flowing through a circuit in amperes (amps).

**12. Voltmeter:** A voltmeter measures the voltage difference between two points in a circuit in volts.

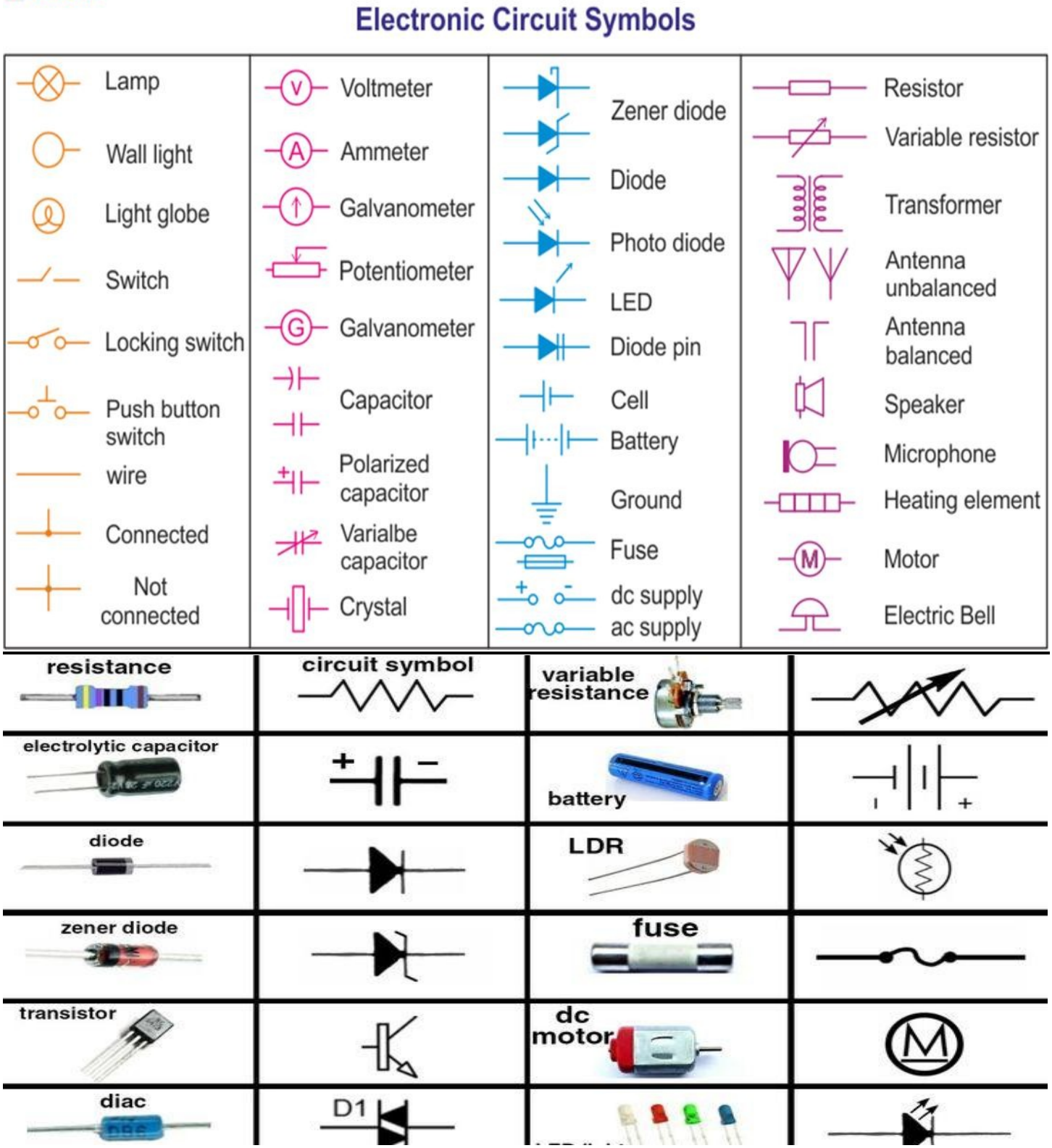
**13. Ohmmeter:** An ohmmeter measures the electrical resistance of a component or circuit in ohms.

**14. Inductors:** Inductors store energy in a magnetic field when current flows through them and are used in filters, oscillators, and power supply circuits.

**15. Variable resistors (rheostat):** Variable resistors allow for adjustable resistance in a circuit, useful for controlling voltage levels or adjusting device setting

**16. A resistor color code** is a system of colored bands used to indicate the resistance value, tolerance, and sometimes the temperature coefficient of a resistor. By interpreting the colors of these bands, one can determine the resistance value of the resistor.

testbook



**The Positive (P) region and Negative (N) region of the PN junction diode and construct a simple electronic circuit comprising a 3V battery made of two dry cells in series with a switch and an LED.**

## Formation of diode

Diodes are formed from a doped semi-conductor when joined n-type and p-type semiconductors.

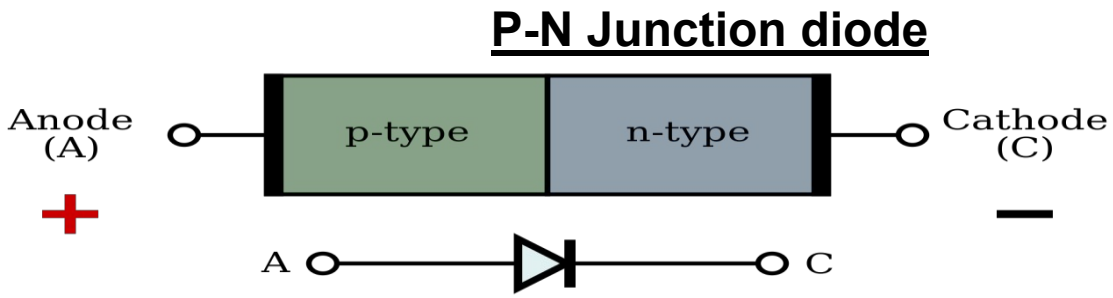
**Semi-conductor.** This is a material whose electrical conductivity lies between a conductor and insulator. E.g. Silicon, germanium etc.

**Doping** This is a processing of adding impurities or foreign material to a semi-conductor in order to improve its electrical conductivity..

- **N-type semi-conductor.** This is an semi-conductor doped with **pentavalent impurities** where free **electrons are the majority** charge carries and **holes are minority** charge carries.
- **P-type semi-conductor.** This is extrinsic semi-conductor doped **with trivalent impurities** where **holes are majority** charge carries and **electrons are the minority** charge carriers.

**Difference between N-type and P-type semi-conductor**

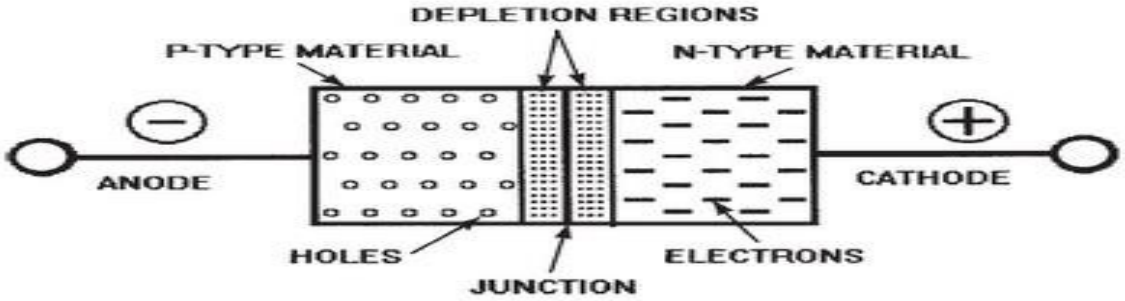
| N-type semi-conductor | P-type semi-conductor |
|---|---|
| The impurity is pentavalent element | The impurity is trivalent |
| The majority charge carrier are electrons | The majority charge carrier are holes |
| Electrical conductivity is much higher | The electrical conductivity is high. |




## Formation of p-n junction diode

**P-n junctions** are formed by joining n-type and p-type semiconductors.
The formation of a PN junction diode involves the coming together of two types of semiconductor materials: P-type (positively doped) and N-type (negatively doped). Here's a step-by-step explanation of how a PN junction diode is formed:
1. Start with Semiconductor Material: The process begins with a semiconductor material such as silicon or germanium, which has four valence electrons.
2. Doping: To create the P-type region, a trivalent impurity (such as boron) is added to the semiconductor material. This trivalent impurity has three valence electrons, creating "holes" in the crystal lattice where an electron is missing.
3. Doping for N-type Region: To create the N-type region, a pentavalent impurity (such as phosphorus) is added to the semiconductor material. This pentavalent impurity has five valence electrons, resulting in an extra electron available for conduction.
4. Diffusion: The P-type and N-type regions are created separately on the same semiconductor crystal. Through a process called diffusion or ion implantation, the dopants diffuse into the semiconductor material to create the P and N regions.

5. Formation of PN Junction: The P-type and N-type regions are brought into contact, forming what is known as a PN junction. At the junction, free electrons from the N-type region migrate to fill the "holes" in the P-type region, creating a depletion region with no mobile charge carriers.
6. Barrier Potential: Due to the migration of charges at the junction, an electric field is established across the depletion region, creating a potential difference known as the barrier potential.




**To construct a simple electronic circuit comprising a 3V battery made of two dry cells in series with a switch and an LED, you can follow these steps:**

1. Connect the positive terminal of one dry cell to the negative terminal of the other dry cell. This will create a series connection, effectively doubling the voltage to 3V.
2. Connect the positive terminal of the second dry cell to one terminal of the switch.
3. Connect the other terminal of the switch to the anode (positive terminal) of the LED.
4. Connect the cathode (negative terminal) of the LED to the negative terminal of the first dry cell.
5. Once the circuit is complete, you can use the switch to control the flow of current through the circuit. When the switch is closed, the LED should light up.

**What happens when the switch in an electronic circuit is closed and opened**

When the switch in an electronic circuit is closed, ***it completes the circuit and allows current to flow. This means that the path for the flow of electrons is complete, and electricity can move from the positive terminal of the battery to the negative terminal.***

When the switch is opened, ***it breaks the circuit and interrupts the flow of current. This means that the path for the flow of electrons is broken, and electricity cannot move from the positive terminal of the battery to the negative terminal.***

**The function of each electronic component such as resistor, diode, and. Inductor and their interdependence for the functioning of an electronic gadget.**

Each electronic component in a circuit has a specific function that contributes to the overall functioning of an electronic gadget. Here is a brief explanation of the function of each component and their interdependence:

**1. Resistor**: A resistor is used to control the flow of current in a circuit. It resists the flow of electrons and reduces the voltage. Resistors are often used to limit current, divide voltage, or provide a specific resistance value in a circuit.

**2. Diode:** A diode is a semiconductor device that allows current to flow in one direction while blocking it in the opposite direction. It acts as a one-way valve for electric current. Diodes are commonly used to convert AC (alternating current) to DC (direct current), protect circuits from reverse polarity, and regulate voltage.

**3. Inductor:** An inductor is a passive electronic component that stores energy in a magnetic field when current flows through it.

It resists changes in current flow and can store and release energy. Inductors are often used in circuits to filter out unwanted frequencies, store energy in power supplies, and create magnetic fields for various applications.

The interdependence of these components is crucial for the functioning of an electronic gadget. For example,

**A diode** may be used in conjunction with a resistor to regulate the voltage in a circuit.

**An inductor** may be used with a diode to create a voltage boost or to filter out unwanted frequencies.

**Resistors** are commonly used in combination with other components to control current flow and voltage levels.

**The roles and the significance of electronic components**:
**I. LED (Light Emitting Diode):** An LED is a semiconductor device that emits light when an electric current passes through it. Leds are commonly used for indicators, displays, and lighting purposes in electronic circuits. They are polarized, meaning they have a positive and negative terminal, and they emit light when forward biased.
**Ii. Resistor:** A resistor is an electronic component that limits the flow of electric current in a circuit. It is used to control the amount of current or voltage in a circuit by providing resistance. Resistors are typically used to protect other components from excessive current and to adjust signal levels.

**Iii. Diode:** A diode is a two-terminal electronic component that allows electric current to flow in one direction while blocking it in the opposite direction. It acts as a one-way valve for electric current. Diodes are commonly used in rectifier circuits, voltage clamping circuits, and signal demodulation circuits.

**Iv. Inductor:** An inductor is a passive electronic component that stores energy in a magnetic field when current flows through it. It resists changes in current flow and can store energy in the form of a magnetic field. Inductors are commonly used in circuits to control current, filter out unwanted frequencies, and store energy.

***How the electronic components affect each other***
In a circuit, these components can affect each other in various ways. For example,
**A resistor** can limit the current flowing through an LED to prevent it from burning out.

**A diode** can be used in conjunction with an LED to ensure that current flows in the correct direction.

**An inductor** can affect the behavior of a circuit by storing and releasing energy, which can impact the overall performance of the circuit.

**The changes in brightness in a LED in relation to addition of resistors, diodes, and inductors in an electronic circuit**

When it comes to changes in brightness in an LED in relation to the addition of resistors, diodes, and inductors in an electronic circuit, each component plays a specific role in controlling the current and voltage that reaches the LED.

**1. Resistors**: Adding resistors to the circuit can limit the current flowing through the LED. This is important because LEDs are current-driven devices, and excessive current can cause them to overheat and fail. By adjusting the resistance, you can control the amount of current flowing through the LED, which directly impacts its brightness.

**2. Diodes:** Diodes are often used to control the direction of current flow in a circuit. When used with LEDs, they ensure that current flows in the correct direction through the LED, allowing it to illuminate.

**3. Inductors:** Inductors are components that store energy in a magnetic field when current flows through them.

In the context of an LED circuit, inductors can be used to smooth out fluctuations in current and voltage, providing a more stable power supply to the LED. This can help maintain consistent brightness, especially in circuits where variations in power supply could affect LED performance.

**NOTE** It's important to note that the specific values and configurations of the resistors, diodes, and inductors in the circuit will determine the exact impact on the LED's brightness. Additionally, other factors such as the power supply voltage and the LED's characteristics can also influence the brightness.

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 3: CONVERSION AND CONSERVATION OF ENERGY

**B7.4.3.1.1 Explain the principle underlying conservation and conversion of energy**

**Conservation of Energy**

**Energy conservation** means saving energy through activities such as switching electric appliances off when not in use, putting measures in place to save energy (money).

**Law of conservation of energy**

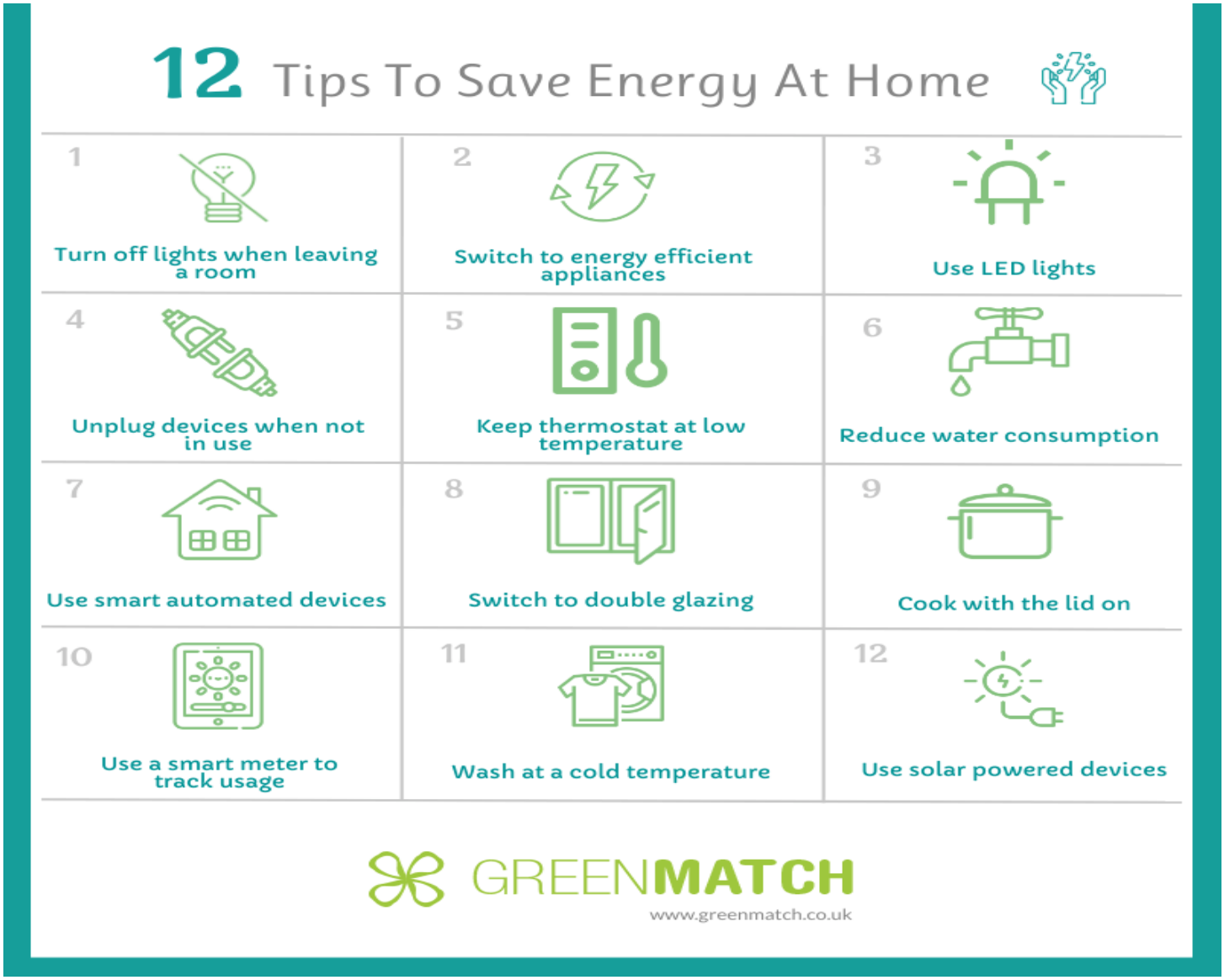
**The law of conservation of energy** states that energy cannot be created nor destroy, but it can be converted or transform or transfer from one form to another.

**Ways of conserving energy or how energy is conserved**

- Putting out fire lamps when not in use.
- Switching off electric appliances when not in use.
- Closing all windows and doors when using an air conditioner.
- Not leaving fridges and deep freezers open for a long time.
- Not putting hot food in fridges and deep freezers.
- Use energy saving lamps.
- Ironing clothes in bulk.

**Efficiency of energy conservation**

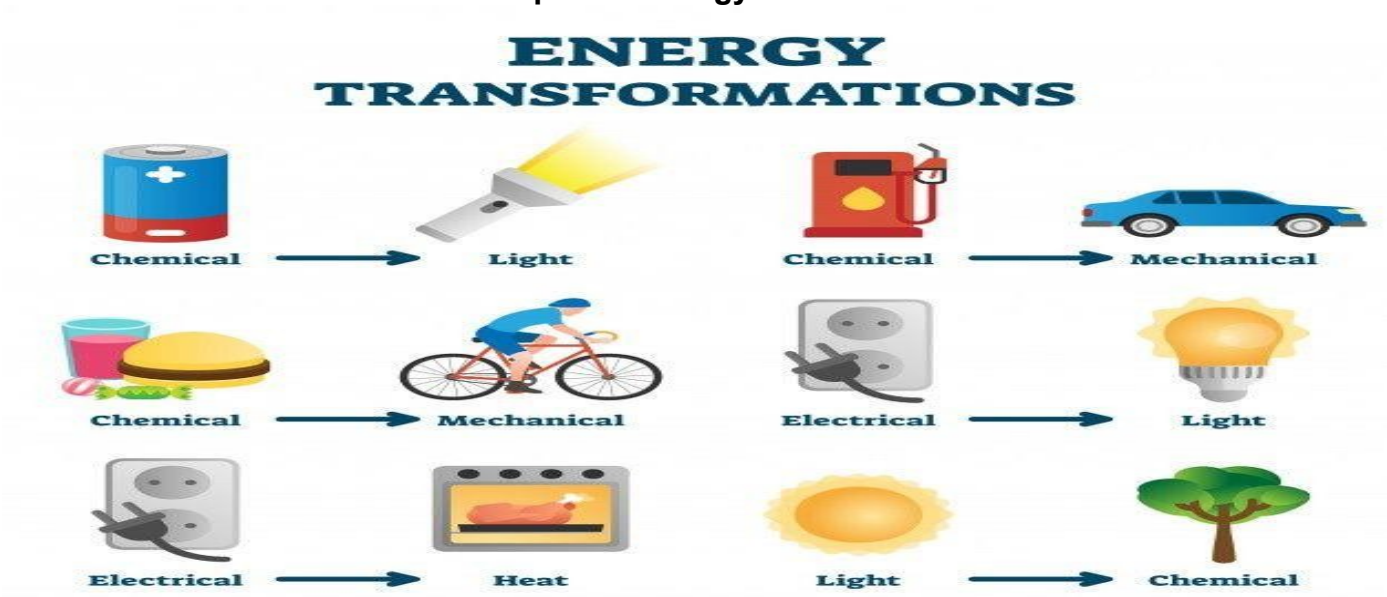
**Efficiency of energy** is the practice of using less energy to perform the same task



**Energy should be conserved for several reasons**.
Here are a few:
1. Conserving energy helps reduce greenhouse gas emissions.
2. It saves money on energy bills.
3. It reduces the need for new power plants.
4. It helps protect the environment and natural resources.
5. It contributes to energy security and independence.

## Energy Transformation

**Examples of energy transformation**




| Scenario | Energy conversions involved |
|---|---|
| ***Rubbing both hands together for warmth*** | Kinetic Energy to Thermal Energy |
| ***A falling object speeding up*** | Gravitational Potential Energy to Kinetic Energy |
| ***Using battery-powered torchlight*** | In the battery: Chemical to Electrical Energy<br>In the bulb: Electrical to Radiant Energy |
| ***In Geothermal Power Plant*** | Heat Energy to Electrical Energy |
| ***In Thermocouple*** | Heat Energy to Electrical Energy |
| ***In Hydroelectric Dams*** | potential energy to kinetic energy to Electric Energy |
| ***In Electric Generator*** | Kinetic energy / Mechanical Energy to Electric Energy |
| ***In Windmills*** | Wind Energy to Mechanical Energy or Electric Energy |
| ***In OTEC (Ocean Thermal Energy Conversion)*** | Heat Energy to Electric Energy or Mechanical Energy |
| ***Using Microphone*** | Sound Energy to Electric Energy |
| ***Photosynthesis in Plants*** | Solar Energy to Chemical Energy |
| ***In Piezoelectrics*** | Strain Energy to Electric Energy |
| ***In Electric lamp*** | Electric Energy to Heat Energy and Light Energy |
| ***Burning of wood*** | Chemical energy to Heat and Light Energy |
| ***In Fuel cells*** | Chemical Energy to Electric Energy |
| ***In steam engine*** | The heat energy to Mechanical Energy |
| ***In Electric heater*** | Electric Energy to Heat |

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 4: FORCE AND MOTION

**B7.4.4.1.1 State and explain Newton's First Law of motion**

**Indicator: B7.4.4.1.1: Understand that unbalanced forces acting on an object cause it to move.**

**The term "force"** *refers to a push or pull that can cause an object to accelerate, change its shape, or change its direction of motion.* Force is a fundamental concept in physics and is measured in units called **Newton (N) .** It can be exerted by physical objects, such as when you push a door open, or by non-physical entities, such as gravity pulling objects towards the Earth. Forces can be categorized into different types, such as contact forces (like friction or tension) and non-contact forces (like gravity or electromagnetic forces). **A force gauge (also called a force meter)** is a measuring instrument used to measure forces

**F = mg** where m is the mass of the object and g is the acceleration due to gravity. Always g = 10 $m/s^2$

**1. How much net force is required to accelerate a 1000 kg car at 10 $m/s^2$?**

*Solution:*

Given,

- A = 10 $m/s^2$
- M = 1000 kg

Therefore,

F = ma

= 1000 × 10

= 10000 N

**Q.2) Aimee has a toy car mass of 2 kg. How much force should she apply to the car so that it should travel with the acceleration of 10 $m/s^2$?**

*Solution:*

Known,

- M (Mass of toy car) = 2 Kg,
- A (Acceleration) = 10$m/s^2$,

F is Force to be applied by Aimmee = m × a

= 2 Kg × 10 $m/s^2$ = 16 $Kgm/s^2$ = 20 N.

**Q.3) A hammer having a mass of 1 kg going with a speed of 10 $m/s^2$ hits a wall and comes to rest in 0.1 sec. Compute the obstacle force that makes the hammer stop.**

**Activities that involve force can vary depending on the context. Some examples of activities that involve force are:**

1. Weightlifting: This activity involves using force to lift heavy weights and build strength.
2. Martial arts: Martial arts require the use of force to perform techniques such as punches, kicks, and throws.
3. Rugby or American football: These sports involve physical contact and the use of force to tackle opponents and gain possession of the ball.
4. Tug of war: This game involves two teams pulling on opposite ends of a rope, using force to try and move the other team towards their side.
5. Hammer throw: This athletic event involves using force to spin and throw a heavy hammer as far as possible.
6. Powerlifting: Similar to weightlifting, powerlifting involves using force to lift heavy weights in three specific lifts: squat, bench press, and deadlift.

**Effects of force on an object**

1. Acceleration
2. Change in shape
3. Change in direction
4. Change in speed
5. Change in position

**Types of force**

**1. Contact Forces:** These forces require physical contact between two objects. Examples include friction, tension, normal force, and applied force.

**A. Frictional Force**: This force opposes the motion of an object when it comes into contact with a surface. It can be further categorized into static friction (when the object is at rest) and kinetic friction (when the object is in motion).

**Ways of preventing friction**
A. Greasing or oiling
B. Using ball bearings at a movable part of a machine
C. Smoothing surfaces in contact

**Advantages of friction:**
- Friction enables us to walk freely.
- It helps to support ladder against wall.
- It becomes possible to transfer one form of energy to another.
- Objects can be piled up without slipping.
- Breaks of vehicles work due to friction.

**Disadvantages of friction:**
- Friction produces heat which damages the moving parts of a machine.
- Friction produces wear and tear on the contacting surfaces. This reduces the life of machine parts, tyres and shoe soles.
- A lot of energy is wasted due to friction to overcome it before moving.

**B. Tension Force:** This force is exerted by a string, rope, or cable when it is pulled tight. It acts in the direction of the string and helps to support or move objects.

**C. Normal Force:** This force is exerted by a surface to support the weight of an object resting on it. It acts perpendicular to the surface.

**D. Applied Force**: This force is exerted by a person or an object to push or pull another object.

**2. Non-Contact Forces:** These forces do not require physical contact between objects. Examples include gravitational force, electromagnetic force, and nuclear force.

**A.. Gravitational Force**: This force is the attraction between two objects with mass. It is responsible for the weight of objects and the motion of celestial bodies.

**B. Electromagnetic Force:** This force is responsible for the interaction between electrically charged particles. It includes forces like electrostatic force and magnetic force.

**C. Nuclear Force**: This force is responsible for holding the nucleus of an atom together. It is a strong force that acts over very short distances.

**D. Centripetal force.** This force acts on an object moving in a circular path, directing it toward the center of the circle around which it is moving. This force is necessary to keep an object in circular motion and prevent it from moving in a straight line.

**E. Centrifugal force.** This is an apparent force that appears to act on an object moving in a circular path, directed away from the center of the circle around which it is moving. It is important to note that centrifugal force is not a "real" force in the traditional sense, but rather a perceived effect that arises from the inertia of the object in circular motion.
When an object moves in a circular path, it experiences a centripetal force directed toward the center of the circle, as I mentioned earlier. However, from the perspective of an observer in a rotating reference frame (such as someone standing on a spinning platform), the object appears to be pushed outward due to its inertia. This apparent outward push is often referred to as centrifugal force.

**E. Electrostatic force**, also known as the Coulomb force, is the force of attraction or repulsion between electrically charged particles. It can also be said to be a force that produced by **static charges** formed on a plastic material which is rubbed vigorously on the hair or fur

**Newton's First Law of motion**
Newton's First Law of motion, also known as the **law of inertia**, *states that an object at rest will stay at rest, and an object in motion will stay in motion with the same speed and in the same direction, unless acted upon by an external force.*
In simpler terms, an object will continue doing what it is doing unless something causes it to change. This law helps us understand the concept of inertia, which is the tendency of an object to resist changes in its motion.

Inertia refers to an object's resistance to changes in its state of motion. According to Newton's first law of motion, an object at rest will stay at rest, and an object in motion will stay in motion with the same speed and direction, unless acted upon by an external force.

**NOTE.** In simpler terms, if an object is not being pushed or pulled, it will continue to stay still or move at a constant velocity. This is because the object has inertia and requires a force to change its state of motion. For example, if you slide a book on a table, it eventually comes to a stop because of the frictional force acting against its motion. The book's inertia keeps it moving until the frictional force slows it down and eventually stops it. Inertia is also related to an object's mass. The greater the mass of an object, the greater its inertia and the more force is required to change its motion.

**Balanced forces** are forces that are equal in size and opposite in direction. Balanced forces do not result in any change in motion. ***Balanced forces occur when the net force is zero, meaning that the forces acting on an object are equal in magnitude and opposite in direction***. In this case, the object remains at rest or continues to move at a constant velocity

**Unbalanced forces** are forces applied to an object in opposite directions that are not equal in size. Unbalanced forces result in a change in motion. ***Unbalanced forces occur when the net force acting on an object is not equal to zero.***
This causes the object to accelerate in the direction of the greater force. Balanced forces occur when the net force is zero, meaning that the forces acting on an object are equal in magnitude and opposite in direction. In this case, the object remains at rest or continues to move at a constant velocity.

**Inertia** *It is defined as the tendency of an object or a body to resist motion. Or*
***Inertia*** *is the tendency of an object to resist changes in its state of motion.*
It is related to an object's mass, where objects with *greater mass have greater inertia.* Inertia can be observed when an object at rest tends to stay at rest, and an object in motion tends to stay in motion unless acted upon by an external force

1**. Inertia of rest**: An object stays where it is placed, and it will stay there until you or something else moves it. With no external force this ball will never move with no external force the ball will never stop
2. **Inertia of motion**: An object will continue at the same speed until a force act on it.
3. **Inertia of direction**: An object will stay moving in the same direction unless a force acts on it.

**Indicator: B7.4.4.1.3 Examine the application of Newton' First Law of Motion in life.**
Newton's First Law of Motion, also known as the law of inertia, states that an object at rest will stay at rest, and an object in motion will stay in motion with the same speed and direction, unless acted upon by an external force. This law has various applications in everyday life. Here are a few examples:
1. Seatbelts in cars: When a car suddenly stops, the passengers tend to keep moving forward due to their inertia. Seatbelts are designed to apply an external force on the passengers, preventing them from continuing to move forward and keeping them safe.
2. Slipping on a wet floor: If you walk on a wet floor, your foot may slide forward due to the lack of friction. This happens because your foot's inertia wants to keep it moving forward, even though the floor is slippery. To prevent accidents, it's important to be aware of this and take precautions.
3. Pushing a shopping cart: When you push a shopping cart, it tends to keep moving forward even after you stop pushing it. This is because of its inertia. To stop the cart, you need to apply an external force in the opposite direction to overcome its inertia.

**Reasons why Newton's First Law of Motion is important**
Newton's First Law of Motion, also known as the law of inertia, is of great importance in understanding the behavior of objects in motion. Here are some reasons why it is important:

1. Predicting motion: Newton's First Law helps us predict how objects will behave when no external forces are acting upon them. It states that an object at rest will remain at rest, and an object in motion will continue moving at a constant velocity unless acted upon by an external force. This law allows us to make accurate predictions about the motion of objects in various scenarios.
2. Understanding inertia: The First Law introduces the concept of inertia, which is the tendency of an object to resist changes in its motion. It helps us understand why objects tend to stay at rest or keep moving in a straight line unless acted upon by an external force. Inertia is a fundamental property of matter and plays a crucial role in many aspects of physics.
3. Designing safer vehicles: Newton's First Law is essential in designing safer vehicles. It helps engineers understand how objects, including passengers, will behave in the event of sudden

acceleration, deceleration, or changes in direction. By considering inertia and the forces acting on objects, engineers can design seat belts, airbags, and other safety features to protect occupants during collisions.
4. Explaining the universe: Newton's First Law is not only applicable on Earth but also extends to the motion of celestial bodies. It helps us understand the motion of planets, moons, and other objects in space. By applying this law, scientists can explain why planets continue to orbit the sun without any external force acting upon them.

## MAGNETISM

**Magnetism** is the force of attraction or repulsion between two object which are not in contact. Magnetism is present in all materials but at such low levels that it is not easily detected.

**Magnet** is any piece of material that has the property of attracting iron (or steel).

**Magnetic and nonmagnetic materials.**
**Magnetic materials** are substances that can be attracted by a magnetic.
**Examples are** iron, cobalt, nickel and their alloys such as steel, nichrome, etc.

**Non-magnetic materials** substances that cannot be attracted or repelled by magnets.
Non-magnetic materials are substances that are not easily magnetized and do not retain magnetic properties. Examples of non-magnetic materials include wood, glass, plastic, copper, aluminum, and stainless steel. These materials are not attracted to magnets and do not exhibit magnetic behavior under normal conditions.

### Uses of magnet

- It is used for studying / research
- In microphones/ loudspeakers
- In television sets to direct electron beam
- In compasses to seek direction.
- For picking pins/nails.
- In freezer doors.

**Types of magnets**

1. **Permanent magnetic.** This refers to the ability of magnetic material to keep or maintain its magnetism over a long period of time.

**Uses of permanent magnetic**

- In refrigerator doors.
- To build electric motor or power windows in cars.
- In electricity generators.
- In cathode ray tubes.
- It is use in compasses.
- Magnetic screw drivers.
- In electric train.
- In television/ computers/ phones.

2. **Temporary magnet.** This is the ability of magnetic material to lose their magnetic property when the magnetizing cause is discontinued.

**Uses of temporary magnetic**

- It is used as electromagnets.
- It is used to separate materials of iron from scrap metals.

**Distinction/difference between permanent and temporary magnet**

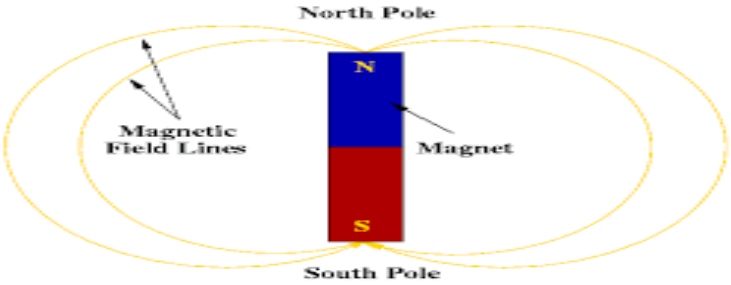
| Permanent magnet | Temporary magnet |
|---|---|
| It is made from hard magnetic substances | It is made from soft magnetic substances. |
| Maintain magnetism for long time | Possess magnetism only in the presence of a magnetic field. |

**How a magnetic material can be differentiated from a non-magnetic material?**

- Bring a magnet close to the material
- Magnetic material gets attracted to or repelled by the magnet.
- The non-magnetic material is neither attracted nor repelled.

**Pole of a magnet**

This refers to the part of the magnet where the magnetic force is strong.

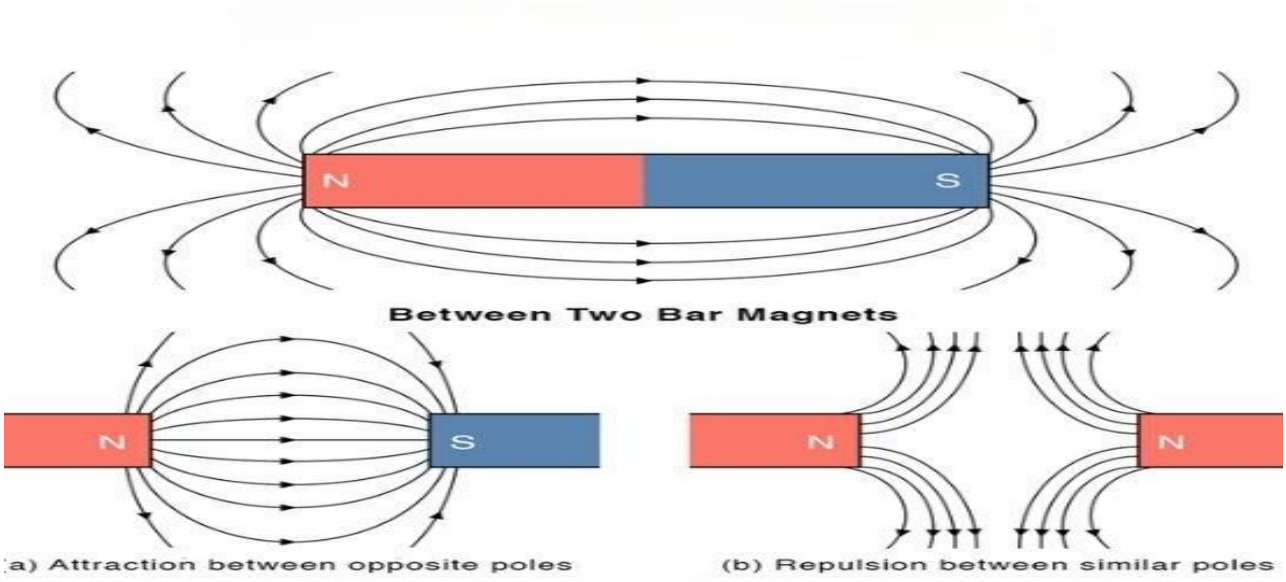



**Law of magnetism**

It states that like poles (N-N or S-S) of two magnetic repel each other, while unlike poles (N-S or S-N) attracts each other.

**That is;**

- Like poles (north-north or south-south) repel each other.
- Unlike poles (north-south or south-north) attract each other.




**Ferromagnetic materials** They are materials which can be magnetized strongly.

**Examples**

- Cobalt - Alcomax
- Nickel - Ticonal
- Iron

**Uses of magnets in everyday life**

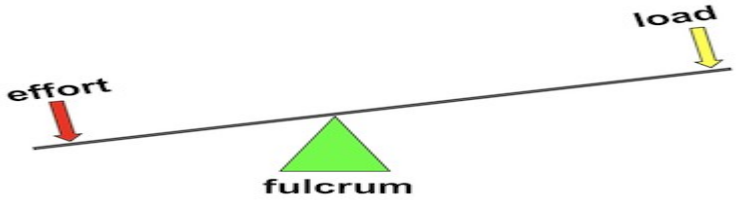
- **Telephone earpiece.** It translates electrical information into physical sound waves.
- **Loud speakers.** It produces sound by the interaction of a permanent magnet and electromagnet.
- **Microphones.** It is used to converts sound into a small electrical current.
- **Magnetic compass.** It is used in airplane and ships to determine their location.
- **Generation of electricity.** Moving a magnet around a coil of wire pushes the electrons in the wire and creates an electric current.

- **Fridge doors.** It is use to allow the doors to stay closed when you wanted them to, but open from the inside with a little push

**Content Standard: B7.4.4.2: Recognise some simple machines, and their application in doing work.**
**Indicator: B7.4.4.2.1: Identify simple machines.**

A simple machine is a mechanical device that helps to make work easier by changing the direction or magnitude of a force. It typically has few or no moving parts and operates on the principle of mechanical advantage.
*Some examples of simple machines include levers, pulleys, inclined planes, wedges, screws, and wheels and axles*.

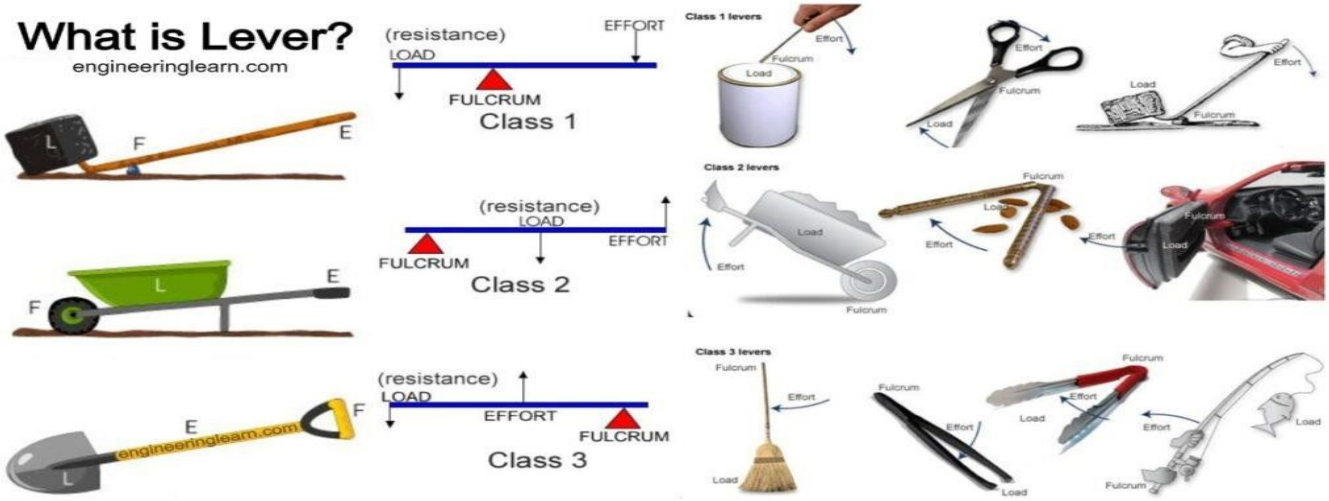
**There are categories of simple machines**.
These categories help us understand and classify different types of simple machines based on their characteristics and functions They are:
**1. Lever**: A lever is a rigid bar that rotates around a fixed point called a fulcrum. It can be used to increase force or change the direction of a force.
The parts of a lever are the **fulcrum, the effort, and the load**.




The fulcrum is the fixed point around which the lever rotates.
The effort is the force applied to the lever to move the load.
The load is the object or weight that is being lifted or moved by the lever.

**Levers are categorized into three classes based on the position of the fulcrum, load, and effort. Here are the classes of levers along with examples:**

- **First-class lever:** In a first-class lever, the fulcrum is located between the load and the effort. Examples of first-class levers include a seesaw, scissors, and a crowbar.
- **Second-class lever:** In a second-class lever, the load is located between the fulcrum and the effort. Examples of second-class levers include a wheelbarrow, a nutcracker, and a bottle opener.
- **Third-class lever:** In a third-class lever, the effort is located between the fulcrum and the load. Examples of third-class levers include a broom, a fishing rod, and a baseball bat.



**2. Pulley:** A pulley is a wheel with a grooved rim that is used to change the direction of a force. It can be fixed or movable and can also provide mechanical advantage. Examples window blinds, elevator

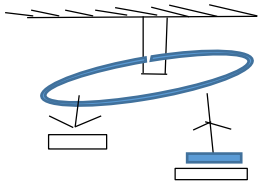
**Uses of pulley**

- It is used to lift water from a well.
- It is used to lift mortar, cement or blocks to the top of a building under construction.
- It is used to hoist or raise a flag.

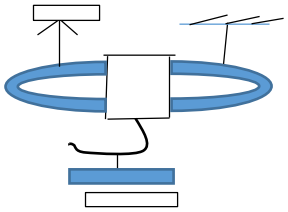
**Types of pulley**

1. Fixed pulley
2. Movable pulley

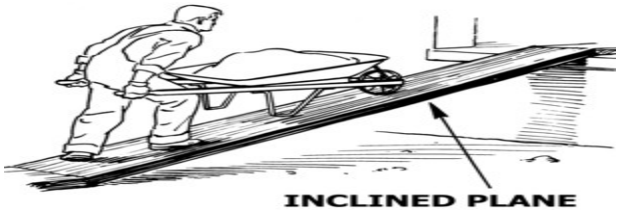
**Fixed pulley**



**Movable pulley**



**3. Inclined Plane:** An inclined plane is a flat surface that is tilted. It allows objects to be moved up or down with less force over a longer distance. Examples ramp, stairs, slide



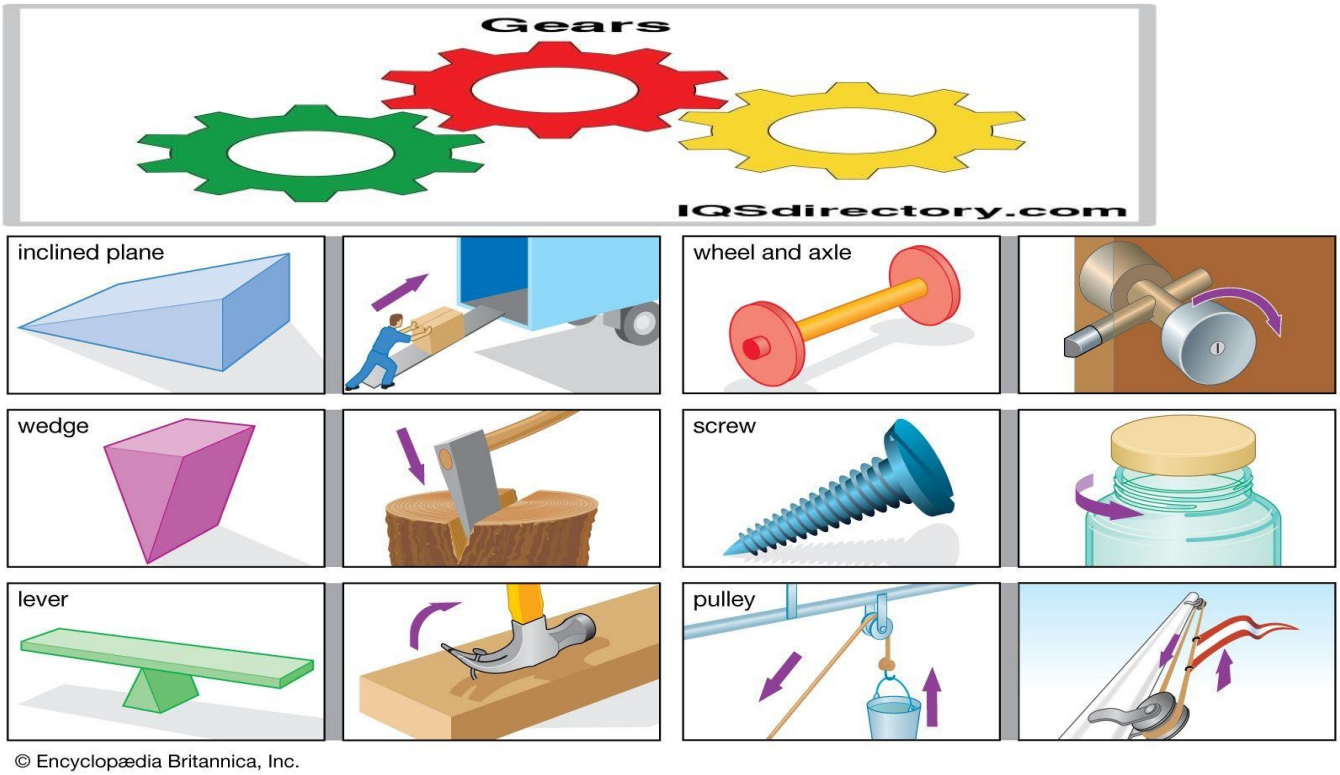

**4. Wedge:** A wedge is a triangular-shaped object that is used to split, lift, or hold objects in place. It works by converting a force applied to its blunt end into a larger force perpendicular to its inclined sides. Examples knife, axe, doorstop


**5. Screw:** A screw is an inclined plane wrapped around a cylinder or cone. It is used to hold objects together or to lift objects by turning it. Examples screwdriver, jar lid, light bulb.

**6. Wheel and Axle:** A wheel and axle is a simple machine consisting of a wheel attached to a smaller axle. It is used to transmit force and can provide mechanical advantage. Examples are bicycle wheel, doorknob, steering wheel.

7. **GEARS.** They are toothed wheels which interlock with similar wheels to transfer a force. E.g. Bicycle wheel where the chain interlocks to transfer force from the bigger wheel to the smaller wheel. It uses are

1. For changing direction
2. Controlling speed



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**Indicators: B7.4.4.2.3 Know Work Input, and Output and Efficiency as they apply to machines.**

**Work input** *refers to the amount of work or energy that is put into a system*.
It is the energy or effort that is required to make something happen or to perform a task. For example, if you are pushing a heavy object, the force you apply to move the object is the work input.
**Work input = Effort × distance moved by the effort.**

***Work output*** *refers to the amount of work or energy that is produced or delivered by a system.*
It is the result of the work input and represents the useful or desired outcome of a process.
In the example of pushing a heavy object, the work output would be the distance the object moves as a result of your force.
**Work out put = load × distance moved by the load.**
The output of a machine is always less than input energy because part of the input energy is used to overcome
**1.** Friction between moving parts of the machine.
**2.** Inertia. **3.** Gravitational force

**Mechanical advantage, velocity ratio,and efficiency of machine**

**Efficiency of a machine** *is defined as the ratio of the work output to the work input expressed as a percentage*.
The efficiency of a machine is a measure of how effectively it converts input energy into useful output energy. It is usually expressed as a percentage. A machine with high efficiency is able to minimize energy losses and maximize the useful work output.

**NOTE:** The efficiency of a machine is always less than 100% because some or part of the input energy is used to overcome
a) Friction between moving parts of the machine
b) Gravitational force
c) Air resistance

**To improve upon the efficiency of a machine you need to**
I. Decrease friction by oiling and greasing the metal parts of machines to reduce friction.
Ii. Maintaining the machines from time to time.

**The efficiency of a machine can be calculated by dividing the useful output energy by the total input energy, and then multiplying by 100.**

**Efficiency** = WORK OUTPUT × 100
WORK INPUT

**OR**

**Efficiency** = M.A × 100
V.R

1. Calculate the efficiency of a machine if the work output of a machine is 80 and the work input is 1000J.

**Efficiency** = WORK OUTPUT × 100
WORK INPUT

**Efficiency** = 800 × 100 = 80%
1000

2. If the useful output energy is 300 J and the total input energy is 500 J, then the mechanical efficiency is

**Efficiency** = WORK OUTPUT × 100
WORK INPUT
= (300 / 500) × 100 = 60%.

3. If the useful work output is 400 J and the heat input is 800 J, then the thermal efficiency is

**Efficiency** = WORK OUTPUT × 100
WORK INPUT
= (400 / 800) × 100 = 50%

4. If the total output is 600 J and the total input is 800 J, then the overall efficiency is

**Efficiency** = WORK OUTPUT × 100
WORK INPUT
= (600 / 800) × 100 = 75%

**Mechanical advantage** It is ratio of the load to the force applied.

M.A. = LOAD
EFFORT. It has no unit

**Velocity ratio** It is the ratio of the distance moved by the effort to the distance moved by the load.

V.R = DISTANCE MOVED BY THE EFFORT
DISTANCE MOVED BY THE LOAD

**WORKDONE**

Work is said to be done when a force moves a body through a distance in the direction of the force.
WORKDONE = FORCE × DISTANCE.
Work is measured in Joules.

**a. An object is horizontally dragged across the surface by a 100 N force acting parallel to the surface. Find out the amount of work done by the force in moving the object through a distance of 8 m.** **Solution:**

F = 100 N, d = 8 m, **WD = F×d** **WD = 100 x 8** **WD = 800 J**

**POWER** *is define as the rate at which work is done*. And it is measured in **watt (W)**

**b. A garage hoist lifts a truck up 2 meters above the ground in 10 seconds. Find the power delivered to the truck. [Given: 1000 kg as the mass of the truck]**

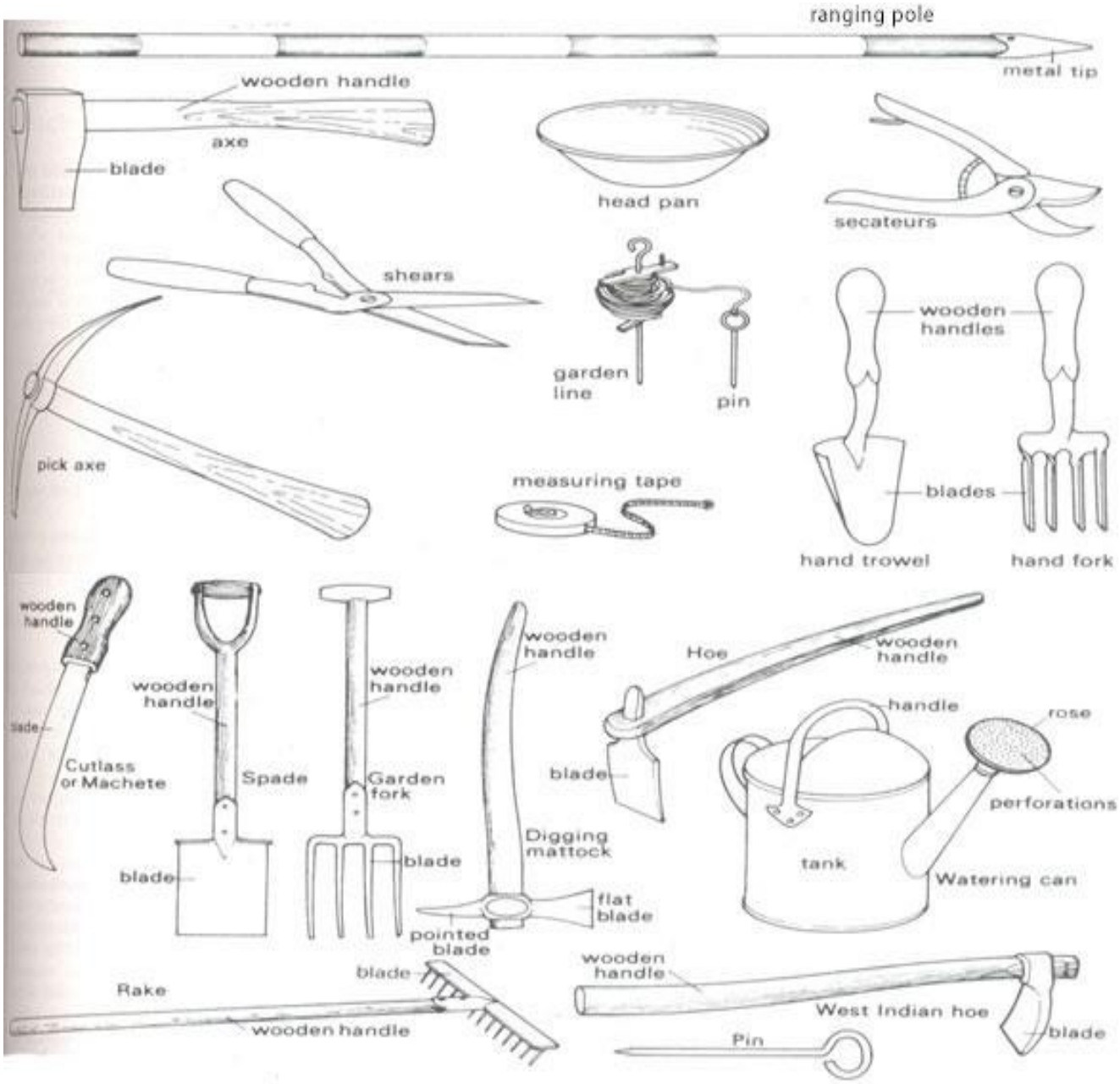
First we need to calculate the work done, which requires the force necessary to lift the truck against gravity: $g=10m/s^2$

F = mg = 1000 x 10 = 10000 N.
WD = F×d = 10000N x 2m = 20000 Nm = 20000 J.
The power is P = W/t = 20000J / 10s
= 2000 J/s = **2000 W.**

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 5: AGRICULTURAL TOOLS
**B7.4.5.1.1 Explain the basic rules in handling and maintaining simple agricultural tools.**

**Farm tools** are instruments or equipment that are used in agriculture to perform various tasks. They are designed to make farming activities more efficient and easier. Some examples of farm tools include shovels, hoes, rakes, wheelbarrows, pitchforks, pruning shears, hand trowels, scythes, sprinklers, and milking machines. These tools are used for tasks such as digging, cultivating, planting, harvesting, and maintaining crops and animals on a farm

1**. Shovel:** Used for digging and moving soil, gravel, or other materials.
**2. Hoe: Used** for breaking up soil, removing weeds, and cultivating the ground.
**3. Rake: Used** for collecting leaves, grass, or other debris, as well as leveling soil.
4. **Wheelbarrow**: Used for transporting heavy loads of soil, plants, or other materials.
5. **Pitchfork**: Used for lifting and moving hay, straw, or other loose materials.
6. **Pruning Shears**: Used for trimming and shaping plants, such as trees, shrubs, or vines.
7. **Trowel:** Used for planting small plants, digging small holes, or transplanting seedlings.
8. **Scythe**: Used for cutting grass, grains, or other crops close to the ground.
9. **Hand Cultivator:** Used for loosening soil, removing weeds, and aerating the ground.
10. **Watering Can:** Used for watering plants, especially in areas where irrigation systems are not available.
11. **Scissors:** Used for trimming and cutting small plants, such as herbs or flowers.
12. **Garden Trowel**: Similar to a regular trowel, but specifically designed for gardening tasks like planting, digging, and transferring soil.
13. **Garden Fork:** Used for turning and aerating soil, as well as lifting and moving larger clumps of dirt or compost.
14. **Secateurs:** Also known as pruning shears, they are used for cutting and trimming branches, stems, or vines.
15. **Garden Gloves**: While not a tool in the traditional sense, gloves are essential for protecting hands from thorns, sharp objects, or chemicals while working in the garden.
16. **A hand fork** is another basic farm tool. It is used for loosening soil, removing weeds, and aerating the ground in smaller areas or tight spaces where a larger cultivator may not be suitable.
**17. A knapsack sprayer** is used for applying insecticides, herbicides and foliar fertilizers.




**The basic rules in handling and maintaining simple agricultural tools include:**

By following these basic rules, you can extend the lifespan of your agricultural tools and ensure they remain safe and effective for use on the farm.

1. Proper storage: Store tools in a clean and dry area to prevent rust and damage. Hang them on hooks or place them in a tool shed or toolbox.
2. Regular cleaning: After each use, clean the tools to remove dirt, debris, and any plant material. Use a brush or cloth to wipe them down and remove any moisture.
3. Sharpening and maintenance: Keep cutting tools, such as shovels, hoes, and pruning shears, sharp and in good condition. Regularly inspect the tools for any signs of wear or damage and repair or replace them as needed.
4. Lubrication: Apply lubricating oil or grease to moving parts, such as hinges or joints, to prevent rust and ensure smooth operation.
5. Proper handling: Use tools for their intended purpose and handle them with care. Avoid using excessive force or applying pressure in a way that could damage the tool or cause injury.
6. Safety precautions: Wear appropriate protective gear, such as gloves or safety glasses, when using tools. Follow safety guidelines and instructions provided by the manufacturer.

7. Regular maintenance: Periodically check and maintain the tools to ensure they are in good working condition. This may include tightening screws or bolts, replacing worn-out parts, or reapplying protective coatings.

**Indicator: B7.4.5.1.2 Maintenance of Agricultural tools.**

Agricultural tools need proper care and maintenance so that they can be used efficiently to perform the various farming operations for a longer period of time

**1. Cleaning**: Regularly clean your agricultural tools to remove dirt, debris, and any plant material that may have accumulated on them. This helps prevent rust and keeps the tools in good condition.

**2. Sharpening**: Sharpen the cutting edges of tools like knives, pruners, and shears to ensure clean and efficient cuts. Use a sharpening stone or file to maintain a sharp edge.

**3. Lubrication**: Apply lubricating oil or grease to moving parts of tools such as hinges, joints, and blades. This helps reduce friction and prevents rust.

**4. Rust prevention**: To prevent rust, store your tools in a dry place and consider using rust inhibitors or coatings. If you notice any signs of rust, remove it using a wire brush or sandpaper.

**5. Handle maintenance:** Inspect the handles of your tools regularly for any cracks or splinters. Sand down rough areas and apply a protective finish, such as linseed oil, to keep the handles in good condition.

**6. Storage:** Properly store your agricultural tools when not in use. Hang them on hooks or place them in a designated storage area to prevent damage and ensure easy access.

**Ways to maintain farm tools:**
1. Clean the tools after each use.
2. Store the tools in a dry and secure place.
3. Regularly inspect the tools for any signs of damage or wear.
4. Sharpen the cutting edges of the tools when necessary.
5. Lubricate the moving parts of the tools to prevent rust and ensure smooth operation.

**Reasons why maintaining farm tools is important:**
1. Extends the lifespan of the tools.
2. Ensures efficient and effective use of the tools.
3. Reduces the risk of accidents or injuries.
4. Saves money by avoiding frequent replacements.
5. Improves overall productivity on the farm.

## STRAND 5: HUMAN AND THE ENVIRONMENT

### Sub-Strand 1: Waste Management Content Standard:

**B7.5.1.1 Exhibit knowledge and skill of scientific basis for management practices of types of waste in the environment. Indicator:**

**B7. 5.1.1.1: Apply information from research on good management practices of waste to make the environment clean.**

**Waste** can also be described as an unwanted material which is no longer needed. It is usually discarded after its primary use.

**Types of waste generated in Ghana**

1. **Municipal Solid wastes**: Solid wastes that include household garbage, rubbish, construction and demolition debris, sanitation residues, packaging materials, trade refuges etc. Are managed by the district or municipal assemblies.
2. **Industrial wastes**: These are liquid and solid wastes that are generated by manufacturing and processing units of various industries like chemical, petroleum, coal, metal gas, sanitary and paper etc. 3. **Institutional wastes**: These are wastes from institutions such as schools, colleges, hospital, university, etc. These wastes include papers, furniture, damaged computers, etc.
4. **Agricultural wastes:** Wastes generated from farming activities. These wastes or substances are mostly biodegradable.
5. **Fishery wastes:** Wastes generated due to fishery activities. These wastes are found in coastal and estuarine areas.
6. **Radioactive wastes:** Waste containing radioactive materials. Usually these are by products of nuclear processes. Sometimes industries that are not directly involved in nuclear activities, may also produce some radioactive wastes, e.g. Radio-isotopes, chemical sludge etc.
7. **E-wastes**: waste from electronic equipment such as end of life computers, phones, and home appliances.
8. **Medical wastes**: Medical waste originates from human and animal healthcare facilities and usually consist of medicines, chemicals, pharmaceuticals, bandages, bodily fluids and body parts. Medical waste can be infectious, toxic or contain bacteria and harmful microorganism.

**Classification of wastes:**

**1.Biodegradable waste:** The waste materials that can be broken down or decomposed into simple forms in nature by **the action of microorganisms** such as bacteria in due course of time are called biodegraded waste materials. They are usually wastes generated from green waste, food waste, wood waste paper waste, etc.

**2. Non-biodegradable wastes:** These are the waste materials that cannot be decomposed or broken down by **natural organisms or agents**. They remain on the earth for thousands of years without degradation. Examples includes plastic water bottles, metals, shoes, etc.

**3. Hazardous wastes:** These are wastes that have the potential of causing harm to the environment and human health. These wastes need special treatments and handling. They are therefore unsafe to use. They possess any of the following characteristics-flammability, corrosiveness, explosiveness, reactivity and toxicity.

**4. Non-hazardous wastes:** These are wastes that are safe to use commercially, industrially, agriculturally, or economically. They do not have any dangerous characteristics. Examples include papers, plastics, glass, metals, beverage cans and organic waste.

**Impacts Of Waste On Health**

1. Chemical poisoning through chemical inhalation.
2. Increase in hospitalization of diabetic residents living near hazardous waste sites.
3. Burning of wastes in the open causes air pollution which has effects on the humans.

**Effects Of Waste On Animals And Aquatics Life**

1. Increase in mercury level in fish due to disposal of mercury in the rivers.
2. Plastic found in oceans is ingested by birds.
3. Results in high algal population in rivers and sea.
4. Degrades water and soil quality.

**Impacts of waste on Environment**

1. Waste breaks down in landfills to form methane, a potential greenhouse gas.
2. Change in climate and destruction of ozone layer due to waste biodegradables.
3. Incinerating waste also causes problems, because plastics tend to produce toxic substances, such as dioxins, when they are burnt.
4. Gases from incineration (burning) may cause air pollution and contribute to acid rain, while the ash from incinerators may contain heavy metals and other toxins.

**The methods used in waste management that are based on several scientific principles.**

These scientific principles, along with various engineering and management practices, form the basis of modern waste management systems. Here are a few key principles underlying these methods:

**1. Source Reduction:** This principle focuses on minimizing waste generation at the source. It involves practices such as reducing packaging materials, using durable and reusable products, and promoting sustainable consumption patterns. By reducing the amount of waste produced, we can minimize the need for disposal and conserve resources.

**2. Recycling:** Recycling is based on the principle of converting waste materials into new products. It involves collecting, sorting, and processing recyclable materials such as paper, plastic, glass, and metal. Recycling helps conserve natural resources, reduce energy consumption, and decrease the amount of waste sent to landfills.

**3. Composting:** Composting is a natural process that converts organic waste, such as food scraps and yard trimmings, into nutrient-rich compost. This process is based on the principles of decomposition and nutrient cycling. Composting helps divert organic waste from landfills, reduces greenhouse gas emissions, and produces a valuable soil amendment for gardening and agriculture.

**4. Waste-to-Energy:** Waste-to-energy technologies are based on the principle of converting waste into usable energy. These methods include incineration, gasification, and anaerobic digestion. By harnessing the energy content of waste materials, we can generate electricity, heat, or biofuels, reducing the reliance on fossil fuels and minimizing the environmental impact of waste disposal.

**5. Landfilling:** Landfilling, as mentioned earlier, involves burying waste in designated areas. This method is based on principles of waste containment, compaction, and environmental protection. Landfills are designed to minimize the release of pollutants into the environment and prevent the contamination of soil and water resources.

## STRAND 5: HUMANS AND THE ENVIRONMENT

### Sub-Strand 2: Human Health

**Content Standard: B7.5.2.1: Demonstrate knowledge of common deficiency diseases of humans, their causes, symptoms, effects and prevention.**

**Indicator: B7.5.2.1.1: Explain the relationship between food nutrients and common deficiency diseases and how they affect humans.**

**Food nutrients** are chemical compounds in food that are used by the body to function properly and maintain good health. Food is anything that we eat and which nourishes our body. It is essential because it contains substances which perform important functions in our body.
Two important features for any item to be called food are:
(i) It should be worth eating, that is, it should be ‗edible'.
(ii) It must nourish the body.

**Nutrition** is the intake of food by a cell or an organism to support life or to stay alive for growth.

**Reasons why good nutrition is important to a pregnant woman.**

- Protein obtained from nutrition is important for the growth or increase in size of embryo or foetus.
- The proteins are important for building foetal body system.
- Fats from food are for the foetal nervous system development.
- Carbohydrates obtained from the food provides energy for the mother to be active.
- Food is important for weight gain in placenta or amniotic sac or enlargement or blood volume or the baby at birth.

**Essential nutrients.** They are nutrients required by the body but cannot be synthesized by the body.

**Balanced diet** It is a diet that contains all the classes of food substances in their correct proportions and quantities needed by the body for effective functioning. A diet which does not have the above qualities, having too much or too little of one of the food classes, may then said to be unbalanced and may lead to malnutrition of one form or the other.

**Malnutrition** It is a condition or situation in an organism where there is insufficient or lack of the required essential food nutrients in the right proportions.

**Effects of Malnutrition**

- Fluid imbalance
- Leads to slow or stunted growth.
- Malformation of tissues
- Death
- Rickets
- Night blindness
- Makes animals and man susceptible to diseases or reduced resistance to diseases.

**Classes of Food and Food Substances**

- Carbohydrates
- Proteins
- Lipids (fat & oil)
- Vitamins
- Mineral salts
- Water.
- Roughage.

**Importance of food nutrients**

1. Food nutrients help the body to acquire energy. This energy is used by the body the organism to carry out its life processes such growth, movement, reproduction, excretion, etc.
2. Food nutrients protect the body against diseases.
3. It helps the body to maintain and repair worn out tissues.

**Carbohydrates** They are the major energy needed in the body to perform any activity. **Examples are,** glucose and fructose in fruits, sugar (sucrose) in sugarcane and sugar beet, starch in bread, potatoes, rice etc.

**Types/division of Carbohydrates**

- Monosaccharides. They are commonly known as simple sugars. Examples are glucose and fructose.
- Disaccharides. They are commonly called complex sugars. Example sucrose.
- Polysaccharides. They may be considered as a chain of several monosaccharide units joined together by chemical bonds. Example starch.

**Sources of Carbohydrates**

Beans, Bread, Milk, Popcorn, Corn, Cookies, Potatoes.

**Uses or functions of Carbohydrates**

- Providing energy and regulation of blood glucose.
- Breakdown of fatty acids and preventing ketosis.
- Sparing the use of protein for energy
- Biological recognition processes.

**Proteins**

**Proteins** are food substances made of the elements carbon, hydrogen, oxygen and nitrogen. They form the main structures of the body. The main unit of protein is **amino acid. Essential amino acids** are those which our body cannot manufacture and hence have to be supplied through the diet. Non-essential amino acids **are those amino acids which our body can manufacture.**

**Sources of Protein.** Meat, fish, eggs, Milk, cheese, curd, soybeans, peas, cereals, nuts and oilseeds like groundnuts, etc.

**Types of proteins**

- **First class protein.** These are usually found in animals and contain all the essential amino acids necessary for proper growth and development.
- **Second class proteins**. These are usually of plant origin and lack some of the essential amino acids.

**Uses of protein**

- In the formation of enzymes, hormones, antibodies, hairs.
- In the repair of the body tissues.
- In the release of energy.
- It provides material for growth

**Disease due to lack protein in human body**

Kwashiorkor, marasmus, cachexia.

**Fats and oils**

They are generally called lipids. They exist as fats in the solid state and as oils in the liquid state. They consist of carbon, hydrogen and oxygen.

**Functions or Ways by which fats and oils are important to the human body**

- Source of energy
- Fat under the skin of mammals provides insulation against heat loss.
- Fat around organs protects such organs.
- Solvent for fat-soluble vitamins.

**Roughage (Dietary fibre)**

**Ways by which Roughage is important to the human body**

- It facilitates free bowel movement or prevents constipation.
- It reduces the risk of bowel cancer.

**The role of Roughage in the diet of humans**

- Roughage aids digestion and makes the food bulky.

- It helps the food to pass through digestive system easily.

**Water** is the major constituent of our body. It forms about two-thirds of the body weight. We can do without food more readily than water. It is present in all the cells, being a vital part of all living tissues. It surrounds tissues and organs, and gives protection from shock.

**Functions:**
It provides a medium for metabolic activities.
It regulates body temperature.

**Ways by which water is important to the human body**
- Involved in all chemical reactions.
- Transportation of substances or food or oxygen.
- Even distribution of heat.
- Prevent constipation
- Maintains osmotic balance of the body.
- Cooling the body when it evaporates from the body surface.

**Mineral salt** (Nutrient essential to growth and metabolism). They are needed for healthy development of the body. Sources of minerals include sea fish and iodated salts.
**Function:** Regulation of metabolic activities or maintenance of good health.
Examples are: Potassium, Calcium, Iodine etc.

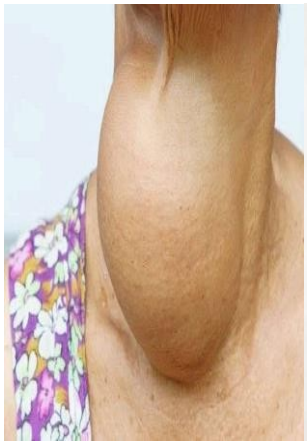
**Deficiency Diseases**
A person may get enough food to eat, but sometimes the food may not contain a particular nutrient. If this continues for a longer period of time, the person may suffer from its deficiency. Deficiency of one or more nutrients can cause disease or disorder in our body.

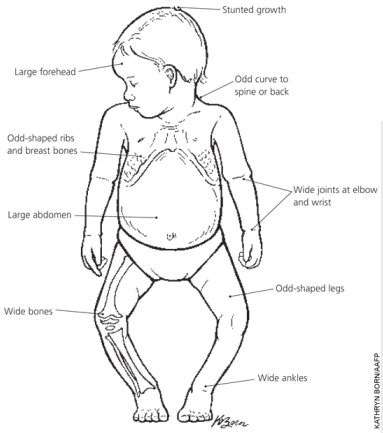
**Deficiency disease** *is the absence or lack of a particular nutrient in the diet of humans.*
Deficiency diseases occur when the body does not receive an adequate amount of essential nutrients, such as vitamins, minerals, or other vital substances. These deficiencies can have various effects on human health, depending on the specific nutrient involved. Here are a few examples:
1. Vitamin C Deficiency (Scurvy): A lack of vitamin C can lead to scurvy, which is characterized by weakness, anemia, gum disease, and skin problems. Without treatment, scurvy can be life-threatening.
2. Iron Deficiency (Anemia): Insufficient iron in the diet can lead to anemia, resulting in fatigue, weakness, pale skin, and difficulty concentrating due to decreased oxygen-carrying capacity in the blood.
3. Vitamin D Deficiency: Inadequate vitamin D can lead to weakened bones, increased risk of fractures, and potential problems with immune function and mood regulation.
4. Iodine Deficiency (Goiter): Lack of iodine can cause enlargement of the thyroid gland, leading to a condition known as goiter. Severe iodine deficiency during pregnancy can also result in stunted growth and intellectual disabilities in children.
5. Vitamin A Deficiency: This can lead to vision problems, increased susceptibility to infections, and potential impacts on growth and development.

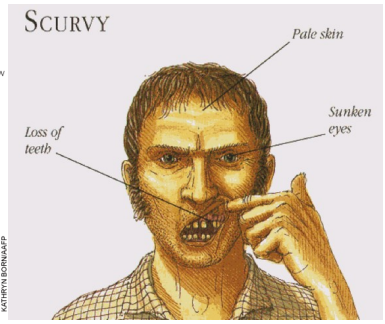
**The following are some common deficiency diseases and their causes**.

| Disease | Cause |
|---|---|
| Kwashiorkor | Lack of protein |
| Rickets | Lack of vitamin D |
| Scurvy | Lack of vitamin C |
| Goiter | Lack of iodine |
| Beriberi | Lack of vitamin B1 |

| | |
|---|---|
| Anaemia or Dermatitis | Lack of Vitamin B2 |
| Night blindness | Lack of vitamin A |
| Marasmus | Lack of carbohydrates |
| Pellagra | Lack of vitamin B3 |
| Prolong bleeding | Lack of vitamin K |






Goitre Kwashiorkor Rickets

**Content Standard: B7.5.2.2 Demonstrate knowledge of the nature of selected viral, diseases of humans, their causes, symptoms, effects and management.**
**Indicator: B7.5.2.2.1 Explain the nature of viral diseases with special emphasis on corona virus (COVID-19) /Ebola/H1N1 disease its causes, symptoms, effects on humans and its prevention.**

## Viral diseases

***Viral diseases*** are caused by viruses, which are tiny infectious agents that can only replicate inside the cells of living organisms.
Viruses are made up of genetic material, either DNA or RNA, surrounded by a protein coat. They cannot survive or reproduce on their own and require a host cell to multiply.

When a person is infected with a virus, the virus enters their body and attaches to specific cells, taking over their machinery to produce more viruses. This process can lead to damage and disruption of normal cell functions, resulting in the symptoms and effects associated with viral diseases.

Viral diseases can vary in their severity and impact on humans. Some viruses cause mild illnesses, while others can lead to severe complications and even death. The symptoms of viral diseases can range from mild respiratory symptoms, such as cough and fever, to more severe symptoms affecting various organs and systems in the body.

Preventing the spread of viral diseases often involves measures such as vaccination, practicing good hygiene, maintaining physical distance, and following public health guidelines. It is important to stay informed about the latest information and recommendations from reliable sources, as the nature of viral diseases can evolve over time.

## CORONA VIRUS.

Corona viruses are a large family of viruses known to cause illness ranging from common cold to a more severe disease such as coronavirus disease 2019 (COVID-19), Middle East Respiratory Syndrome (MERS), Severe Acute Respiratory Syndrome (SARS).
**COVID-19** is a disease caused by a new strain of corona virus known as **SARS-cov-2**. Incubation Period of COVID-19 . *The incubation period is the period between the entering of the corona virus into the human host and the presentation of clinical symptoms or observable signs.* The incubation period of corona virus disease is a between **4 to 6 days**.

**Mode of Transmission of COVID -19**

1. The virus is transmitted to people from wild animals and spreads in the human population through human- tohuman transmission.
2. Human-to-human transmission of the virus happens when someone comes into contact with the infected person‘s secretions. Either through a cough, sneeze or a handshake.
3. The virus can also be transmitted by touching something an infected person has touched and then touching your mouth, nose or eyes.

**Symptoms of COVID -19**

*The common signs and symptoms include:*

- Cough
- Fever (high body temperature)
- Sore throat
- Loss of sense of smell (Anosmia)
- Breathing difficulties.
- Pneumonia, etc.

In a more severe cases infected persons of COVID-19 can have severe acute *respiratory syndrome, kidney failure, and may even lead to death*.

**The following are preventive measures of COVID- 19.**

I. Contact tracing of persons who have come into contact with infected persons.
Ii. Maintain distance of one metre from friends.
Iii. Wash your hands with soap under running water before touching anything including your eyes, nose and mouth.
Iv. Clean your hands with 68% and above alcohol-based sanitizer.
V. Cover your mouth and nose when you cough or sneeze with a handkerchief or disposable tissue paper.
Vi. Avoid sharing items like cutlery sets, drinking bottles, cups, and bowls.
Vii. If symptoms persist and become worse than a standard cold, see your doctor.

**EBOLA**

Ebola virus disease (EVD), formerly known as Ebola haemorrhagic fever is a severe illness in humans. Fruit bats are Ebola virus host.

**Mode of transmission of Ebola.**

i. It is transmitted through close contact with the blood, secretions, organs or other bodily fluids of infected animals such as fruit bats, chimpanzees, gorillas, monkeys, forest antelope or porcupines found ill or dead or in the rainforest.
ii. Ebola then spreads through human-to-human transmission via direct contact with
iii. Blood or body fluids of a person who is sick with or has died from Ebola
iv. Objects that have been contaminated with body fluids (like blood, feces, vomit) from a person sick with Ebola or the body of a person who died from Ebola.

**Symptoms of Ebola**

Fever, sore throat , vomiting ,Muscle pain, Headache, diarrhoea , fatigue, etc.

**Preventive measures of Ebola include:**

- Reducing the risk of wildlife-to-human transmission.
- Reducing the risk of human-to-human transmission.
- Contact tracing of persons who have come into contact with infected persons.

**H1N1 VIRAL DISEASE**

The H1N1 virus is made of swine, human, and avian genes that metamorphosed or was transformed in pigs.

**Mode of transmission of H1N1**

H1N1 virus was transmitted from animals to humans. It spreads quickly among humans because they had no immunity to it. Symptoms of H1N1 o Fever o cough o sore throat o runny nose diarrhoea etc.

**Preventive measures of H1N1 include:**

- Reducing the risk of wildlife-to-human transmission.
- Reducing the risk of human-to-human transmission.

- Contact tracing of persons who have come into contact with infected persons.

**Diseases caused by Viruses (Causative agent)**

| Diseases | Symptoms | Mode of transmission | Prevention/ control |
|---|---|---|---|
| **Measles** | Sore throat, runny nose, water eyes, cough and fever. | Through droplet infected and close contact with infected person. | - Vaccination of young children<br>- Avoiding of overcrowding |
| **Mumps** | Testis, ovaries and pancreas affected. | Airborne or droplet infect. | - Disinfect the utensils and clothes of patient properly<br>- Isolating infected person. |
| **Common cold** | Sneezing and coughing, fever, headache, chills etc. | Airborne, droplet infection contact. E.g. Hand to eye | - Cover your mouth and nose while sneezing.<br>- Having adequate rest. |
| **Chicken pox** | Fever, headache, rashes on the skin. | Airborne, droplet infection. | - Avoid contact with infected person.<br>- Immunization. |
| **Influenza (Sweating sickness)** | Sudden fever with headaches, sore throat, muscular aches. | Airborne, droplet infection | - Vaccination<br>- Keep mouth and nose covered while sneezing. |
| **Poliomyelitis (infantile paralysis)** | Fever, headache, stiffness in neck. | Airborne, food-borne or waterborne | - Polio vaccine to children<br>- Cover mouth and nose while sneezing. |
| **Rabies.** | Headaches, nervousness, fever, paralysis. | Bites of an infected dog | Immunization of dogs and destruction of infected animal. |
| **Hepatitis B** | Infects liver, jaundice, nausea, severe loss of appetite. | Water borne, blood borne and through sexual intercourse | - Hepatitis - B Vaccination<br>- Boiling of drinking water<br>- Drugs. |
| **Newcastle** | Coughing, sneezing, loss of voice. | Highly contagious diseases and the infection is through inhalation and contact | - Effective vaccination at the right times after hatching.<br>- Effective water medication at the right times.<br>- Proper management system. |
| **Avian influenza** | Cough, sore throat, fever. | Directly from wild birds to domestic poultry or indirectly. | - Through breathing machine<br>- Isolation infected person. |

## STRAND 5: HUMANS AND THE ENVIRONMENT

### Sub-Strand 3: Science and Industry

**Content Standard: B7.5.3.1: Realise how careers in science can improve life of humans and research about Ghanaian and internationally recognised scientists and science educators and model after them.**

**What is science?** Science is the method of obtaining knowledge through observation and experimentation.

**Field of science**

1. **Natural science**. This study natural phenomena (including biological life).
2. **Applied science**. This deals with the application of scientific knowledge. E.g. Geology, engineering, m edicine, meteorology etc.

**Fields of Natural science**

- **Biology**. It is the study of living organisms.
- **Physics.** It is the study of the fundamental constituents of the universe, the forces and interactions they exert on one another.
- **Chemistry.** It is the study of the existence and composition of matter.
- **Earth science.** It is an all-embracing term for science related to the planet earth. E.g. Physical geography, geology, oceanology.
- **Astronomy**. This is the science of celestial objects and phenomena that originate outside the Earth's atmosphere. E.g. Stars, planets, comets and galaxies.

**Science & Technology**

Science and Technology have existed since creation. With the discovery of fire, metals and alloys, technology developed into making artefacts from iron, gold, silver and bronze.

**Science** is the study of nature and investigating the way things are made, exist and behave in order to understand the natural world. While **Technology** is the systematic application of scientific ideas (knowledge) in order to improve the lives and meet the needs of society.

**Difference between Science & Technology**

| Science | Technology |
|---|---|
| Science explores new knowledge methodically through observation and experimentation. | Technology is the application of scientific knowledge for various purposes. |
| It is always useful. | It can either be useful or harmful. For example, a computer can be useful, whereas a bomb can be harmful. |
| It stresses on discoveries. | It stresses on inventions. |
| It is used to make predictions. | It simplifies human life and fulfils the need of people. |

**Significance or Importance of Science and Technology to the development of Society**

- ✓ **It has improved Health.** The application of technology has led to the production of vaccines and drugs to fight against diseases such as small pox, measles, tetanus etc.
- ✓ **Improved Communication.** Technology has made accessing, processing and transmission of information easier and faster. Computer, fax machines, mobile phones etc. Have been produced to enhance communication in the world.
- ✓ **Improved Agriculture.** The provision of mechanized farm equipment such as plough and combine harvester is as the result of technology.
- ✓ **Improved Transportation.** Technology has helped in the invention of cars, airplanes, ships and trains to facilitate the movement of goods and people from one place to another.
- ✓ **Improved Education.** Teaching and learning processes in schools have improved as a result of the invention of modernized teaching aids such as electronic boards, slide projectors, computers, videos etc.
- ✓ **Improved Sanitation.** Effective ways of solid and liquid waste disposal and recycling methods, which are the result of technology, have helped us to keep our environment clean.

- ✓ **Discovery of new energy sources**. By the application of technology, we have discovered and developed energy sources, which include hydroelectric power stations, solar energy and biogas to produce electricity and other forms of energy.

**Endogenous Technology**
This is the one that makes use of local resources or skills or techniques or tools and scientific ideas in the production of goods or services.

**Modern Technology**
This is the production of goods or machines or tools use to improved methods to make life easier.

**Reasons why technology in Ghana is not improving**
✓ Inability to replace the old indigenous tools with modern ones.
✓ Inability to learn from foreign technology/ lack of practical software training.
✓ Dependence on local ways of production of goods.
✓ High cost or absence of credit for research and development.
✓ Inadequate tax incentive for companies.
✓ Corruption in public places.
✓ Irregular power supply.

**Ways of improving indigenous tools and technology**
✓ Provision of funds or sponsorship for research work.
✓ Learning from foreign technology and to adapt to suit local ones.
✓ Easy access to low interest rates to expand business.
✓ Expansion of business.

**Technology**
This means the use of scientific knowledge in a practical way. E.g. ICT, food technology.

**Carriers in science and technology**
**Pharmacists:** A pharmacist is a healthcare professional who specialize in the right way to use, store, preserve and provide medicine.
**Pilot:** A pilot is a person who is trained to fly an aircraft.
**Ecologist:** An ecologist is a scientist who studies how animals and plants interact with their environment. To be an ecologist, you must first learn about ecology-the study of organisms and how they relate to their environment.
**Zoologist:** A zoologist is a scientist who study animals and their interaction with the ecosystem. They study their physical characteristics, diets, behaviours, and the impact humans have on them.
**Biologist:** A biologist is a scientist who study animals, humans, plants or even micro-organisms to develop knowledge and understanding of living processes.
**Botanists:** A botanist is a scientist who study plants kingdom.
**Entomologist:** An entomologist is a scientist who studies insects. Study the life cycle, distribution, physiology, behaviour.
**Ethologist:** An ethologist is a scientist who studies the behaviour of animals under natural conditions. They study domestic animals, livestock or wildlife to gain insight about their natural behaviours.
**Forensic scientist:** Forensic scientist collect and analyse evidence from a crime scene. They collect items like dirt samples, blood samples, fingerprints and more. They are responsible for using their expertise to report on and present their findings in legal cases.
**Geochemist:** Geochemists study the appearance, movement and effect of chemical compounds of the earth. This involves the movement and distribution of compounds through water systems, the chemical makeup of minerals.
**Hazardous waste chemist:** Hazardous waste chemists are responsible for monitoring and managing chemical pollutants in the air and water.
**Pharmacologist:** Pharmacologists perform studies on new and existing drugs and other pharmaceuticals for their effectiveness on humans and animals. They also study the source and chemical makeup of drugs.
**Toxicologist:** Toxicologists are responsible for testing various blood and tissue samples to detect the presence of pharmaceuticals, poison, alcohol and other substances in the body.
**Laboratory technician:** A laboratory technician helps physicians to diagnose and treat diseases.

Some of the primary responsibilities of a laboratory technician include performing tests on blood samples, tissue and other body fluids. Software engineer:
**A software engineer** is a scientist who apply scientific and mathematical principles in order to solve problems. They design and create computer software and applications to solve real time problems. Software engineers are sometimes called **software developers**.

**Some Ghanaian Scientist**

*1. Prof. Ibok Nsa Oduro*.
2. Prof. Francis Allotey.
3. Professor Ewurama Addy
4. Professor Anamuah-Mensah
5. Professor Theophilus Ossei-Anto
6. Professor Christian Anthony-Krueger

**Prof. Ibok Nsa Oduro** is a Ghanaian scientist known for his work in the field of environmental science and research. He has made significant contributions to the study of environmental sustainability and conservation in Ghana and beyond.

**Prof. Francis Allotey** was a renowned Ghanaian mathematician and scientist who made significant contributions to the field of mathematical physics and science education. He played a key role in promoting scientific research and education in Ghana.

**Professor Ewurama Addy** was a distinguished Ghanaian biochemist and scientist who contributed extensively to scientific research and education. She was known for her advocacy for science and technology development in Africa, particularly in the field of biochemistry.

**Professor Anamuah-Mensah** is a prominent figure in Ghanaian science education, particularly known for his contributions to the advancement of science curriculum development and educational policy in Ghana.

**Professor Theophilus Ossei-Anto** is recognized for his work in the field of pharmaceutical science and research. He has been instrumental in advancing pharmaceutical research and development in Ghana, contributing to the country's healthcare system.

**Professor Christian Anthony-Krueger** is known for his expertise in the field of agricultural science and research. He has made significant contributions to agricultural development and sustainability in Ghana through his research and educational initiatives.

**Some International Scientists:**

i. Albert Einstein
ii. Alexander Fleming
iii. Charles Darwin
iv. Stephen Hawkins

**I. Albert Einstein:** Albert Einstein was a theoretical physicist best known for developing the theory of relativity, which revolutionized our understanding of space, time, and gravity. His equation E=mc^2 is one of the most famous equations in physics and describes the relationship between energy and mass.

**Ii. Alexander Fleming**: Alexander Fleming was a Scottish biologist and pharmacologist who discovered the first antibiotic substance, **penicillin**, in 1928. His discovery revolutionized medicine and has saved countless lives by providing an effective treatment for bacterial infections.

**Iii. Charles Darwin**: Charles Darwin was a naturalist and biologist who is best known for his theory of evolution by natural selection. His work, particularly his book "On the Origin of Species," laid the foundation for modern evolutionary biology and significantly influenced our understanding of the diversity of life on Earth.

**Iv. Stephen Hawking:** Stephen Hawking was a theoretical physicist known for his contributions to the fields of cosmology and quantum gravity. Despite living with amyotrophic lateral sclerosis (ALS), Hawking made significant advancements in our understanding of black holes, the origins of the universe, and the nature of space and time.

## STRAND 5: HUMANS AND THE ENVIRONMENT

### Sub-Strand 4: Climate Change and Green Economy.

**Content Standard: B7.5.4.1 Demonstrate understanding of sustainable energy choices and their impact on the environment.**

**Indicator: B7.5.4.1.1 Search for information on ways sustainable energy choices and scientific ideas are used to protect the environment.**

Introduction For better understanding of sustainable energy choices there are certain vocabularies that you need to know in order to consolidate your understanding on climate and green economy.

**Weather:** Weather describes the condition of the atmosphere over a short period of time. It describes the state of the atmosphere for example the degree to which it is hot or cold, wet or dry, calm or stormy, clear or cloudy.

**Climate:** is the condition of the atmosphere at a particular location over a long period of time. It is the long-term summation of the atmospheric elements and their variations.

**Climate change**: Is the long term changes to the climate of a region or country, or even the whole world.
The term climate change refers to significant changes in average weather patterns (i.e. Precipitation, temperature, wind and other indicators) that persist within a climate system, caused directly or indirectly by human activities.

**Human activities that influence climate change**

- Burning of fossil fuels
- Deforestation
- Industrial activities
- Mining
- Bad agricultural activities

**Natural factors that influence climate change.**

1. **Solar radiation:** Changes in the intensity of solar radiation reaching the Earth's surface can impact climate patterns. Variations in the Sun's energy output, such as solar flares or sunspot activity, can influence the Earth's temperature.
2. **Volcanic activity**: Volcanic eruptions release large amounts of gases and particles into the atmosphere. These volcanic emissions can affect climate by blocking sunlight and cooling the Earth's surface temporarily.
3. **Ocean currents**: Ocean currents play a crucial role in redistributing heat around the globe. Changes in ocean circulation patterns, such as El Niño and La Niña events, can impact regional and global climate patterns.
4. **Natural greenhouse gases:** Certain gases, such as carbon dioxide ($CO_2$), methane ($CH_4$), and water vapor, occur naturally in the atmosphere and contribute to the greenhouse effect. Changes in the concentrations of these gases can influence the Earth's climate.

**Effects of climate change on the Environment:**

1. Direct physical harm on humans
2. Crop failure and farmland loss
3. Sea level rises and coastal submersion
4. Freshwater loss and desertification

**Causes of uneven heating of the earth's surface**

- ✓ Curvature of the earth's surface or angle at which the sun's rays strike the earth or the earth is a sphere with the equator heated more intensely than the poles.

- ✓ Revolution of the earth around the sun.
- ✓ Difference in land and sea temperatures.
- ✓ Rotation of the earth on its axis.
- ✓ The earth covered primarily with two land and water which get heated and cool at different rates.

**Effects of climate change on biodiversity resources**

- ✓ It changes in vegetation patterns.
- ✓ Changes in plant life cycles
- ✓ Rising levels of sea
- ✓ Warmer oceans
- ✓ Changes in pattern of weather and rainfall.
- ✓ Air and water pollution
- ✓ Population displacement.

**There are several ways to minimize human activities that influence climate change.**

Here are a few examples:

**1. Reduce greenhouse gas emissions**: One of the most effective ways to minimize human activities that contribute to climate change is to reduce greenhouse gas emissions. This can be done by transitioning to renewable energy sources, such as solar or wind power, and by improving energy efficiency in buildings, transportation, and industrial processes.

**2. Promote sustainable transportation:** Encouraging the use of public transportation, carpooling, cycling, and walking can help reduce carbon emissions from transportation. Additionally, supporting the development and adoption of electric vehicles can also contribute to minimizing the impact of human activities on climate change.

**3. Practice sustainable agriculture**: Implementing sustainable agricultural practices, such as organic farming, agroforestry, and precision farming techniques, can help reduce greenhouse gas emissions from the agricultural sector. These practices can also improve soil health and water conservation.

**4. Support reforestation and afforestation**: Planting trees and restoring forests can help absorb carbon dioxide from the atmosphere, as trees act as natural carbon sinks. Supporting initiatives that promote reforestation and afforestation can help mitigate the impact of human activities on climate change.

**The green economy**

*A green economy is one that aims to reduce environmental risks and ecological scarcities while promoting sustainable development*. It's low carbon, resource efficient, and socially inclusive. It involves activities and sectors that focus on reducing carbon emissions, conserving natural resources, and promoting clean and renewable energy sources. The green economy aims to balance economic growth with environmental sustainability.

**Ways we can practice green economy**:
1. Reduce, reuse, and recycle.
2. Use renewable energy sources.
3. Conserve water and energy.
4. Support sustainable agriculture.
5. Promote eco-friendly transportation.
6. Minimize waste generation.
7. Encourage green building practices.
8. Invest in green technologies.
9. Support local and sustainable businesses.
10. Advocate for environmental policies and regulations.

**Sustainable energy choices**

*Sustainable energy choices are derived from resources that can maintain current operations without endangering future energy needs or the climate*. They include renewable sources like wind, solar, geothermal, and hydropower. These energy sources are often renewable, meaning they can be continuously replenished, unlike fossil fuels which are finite resources. *Among the discovered sustainable energy choices are; solar energy, wind energy, hydropower, geothermal energy and ocean energy.*


1. **Solar Energy:** Solar energy is derived by capturing radiant energy from the sun and convert it into electricity. Photovoltaic (PV) systems can convert direct sunlight into electricity through the use of solar cells. Benefits: One of the benefits of solar energy is that sunlight is always available. It improves public health and environmental conditions because there no release of greenhouse gases in the environment.
2. **Wind Energy:** Wind farms capture the energy of the wind by using turbines and converting it into electricity.
3. **Geothermal Energy:** Geothermal energy allows us to fetch energy from beneath the earth. This occurs by installing geothermal power stations that can use the heat coming out from inside the earth to generate electricity. Geothermal energy cannot be harnessed everywhere as high temperature is needed to produce steam that could move turbines. It can be harnessed in areas that have high seismic activity and are prone to volcanoes. They are environment friendly and can produce energy throughout the day but their ability to produce energy at suitable regions restricts us from using it on a much wider scale.
4. **Ocean Energy:** The waves or tides of the ocean have great power which can tapped can generate a lot of energy to power millions of homes. Waves produced at the oceans can be used by ocean thermal plants to convert the kinetic energy in waves to mechanical energy of turbines which can be converted to electrical energy through generators.
5. **Biomass Energy**: Bioenergy is a renewable energy derived from biomass. Biomass is organic matter that comes from living plants and organisms. Using wood in your fireplace is an example of

biomass that most people are familiar with. There are various methods used to generate energy through the use of biomass.

6. **Hydroelectric Power:** There are the rivers or waterfalls whose energy of the moving water when captured that can turn turbines to generate power. This is commonly known as hydroelectric power. It is very common nowadays and it is powering most parts of the world especially Ghana, the Akosombo Dam.

**Ways we can practice sustainable energy choice:**

1. Use solar power.
2. Harness wind energy.
3. Utilize geothermal energy.
4. Invest in hydroelectric power.
5. Promote bioenergy sources.
6. Support tidal and wave energy.
7. Explore nuclear energy options.
8. Implement energy-efficient technologies.
9. Encourage the use of biomass energy.
10. Adopt sustainable heating and cooling systems.

**Need for Sustainable Energy**

The following are some of the reasons why sustainable energy is important to us today

1.**Sustainable energy fights against climate change**. Sustainable energy emits little or no greenhouse gases in their generation. This make them the cleanest and the safest way to prevent environmental degradation or pollution.

2. **Renewable energy will never deplete or run out.** Wind energy, solar power, geothermal energy, and hydropower will continue to 103 provide us with energy as long as the wind blows, the sun shines, and the tides roll in.

3. **Sustainable energy does not harm the environment and can help improve public health.**

4**. Renewable energy resources emit little or no greenhouse gases, which is better for the environment and our health**. The smog produced by fossil fuels irritates our lungs and can lead to lung and respiratory diseases.

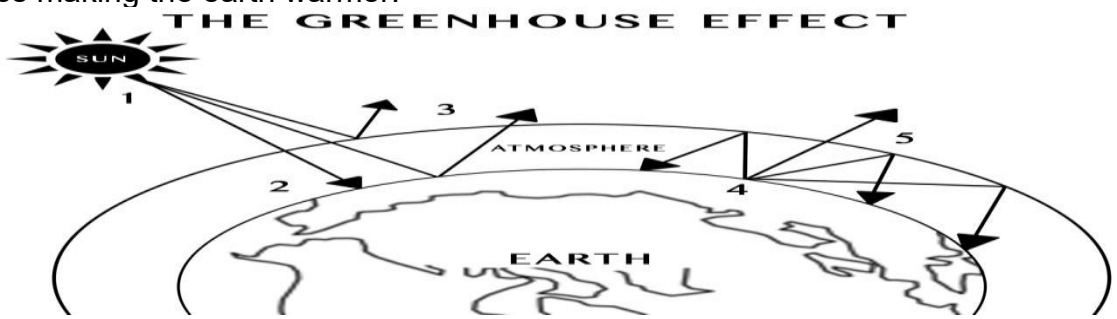
5. **Sustainable energy can reduce or eliminate our reliance on fossil fuels**. Fossil fuels may be reliable and easy to access today, but it won‘t always be the case.

**Advantages of solar energy over the use of fossil fuel as source of energy**

| Solar Energy | Fossil Fuel |
|---|---|
| Renewable energy resources | Non-renewable energy resource |
| Energy independent | Depends very much on other energy sources. |
| Production does not pollute the environment | Production involves a lot of emissions which pollutes the environment. |

## Greenhouse effect

This is the trapping of infrared radiations in the earth‘s surface by gases/ carbon dioxide/ substances making the earth warmer.



**Ozone layer** This is a region of the upper layer containing a relatively higher concentration of ozone molecules that absorb higher energy and harmful UV radiation from the sun, thereby protecting living things. Ozone is made of three oxygen atoms ($O_3$).

**How ozone layer protects living things (Humans)**
The ozone layer absorbs and protect the Earth from too much ultraviolet radiation (harmful radiation) from the sun coming into the contact with humans.

**Ozone layer depletion**
This is the formation of holes in the ozone layer due to the destruction of the ozone molecules.

**Causes of ozone depletion**
- ✓ Chlorofluorocarbons (cfcs). This is the main chemical that destroy the ozone layer.

**Effects of the depletion of the ozone layer**
- ✓ Ultraviolet rays penetrating it and hence increasing global warming.
- ✓ UV rays which fall on human skin can cause skin cancer.

*UV rays can affect plant micro-organisms which help to absorb and utilize nitrogen thereby affecting food crop yield*.

**Examples of greenhouse gases or Gases which contribute to greenhouse effect**
- ✓ Carbon dioxide
- ✓ Methane
- ✓ Nitrous oxide
- ✓ Water vapour
- ✓ Ozone
- ✓ Chlorofluorocarbons/ cfcs.

**Causes an Increase in Greenhouse gases**
- ✓ **Carbon dioxide.** This is added to the atmosphere when people burn coal, oil (gasoline), and natural gas (**fossil fuels)**, for transportation, factories, and electricity.
- ✓ **Deforestation**, or the clearing of forests. This also increases the amount of **carbon dioxide**
- ✓ In the air because in ***photosynthesis*** plants take in carbon dioxide and remove it from the atmosphere, they make oxygen.
- ✓ ***Volcanoes, fires, and respiration (breathing)*** **also add $CO_2$** to the atmosphere.
- ✓ **Methane.** This is produced when **garbage is buried in landfills**, from **animal waste** (poop), and from other natural sources.
- ✓ As temperatures increase, **evaporation** increases which adds **water vapor.**

**Effects of greenhouse on climate**
- ✓ It changes in rainfall patterns.
- ✓ Evaporation of water from the earth surface
- ✓ Prolonged drought
- ✓ Global warming or rise in temperature.
- ✓ Melting of ice or flooding.

**Global warming**
This is an increase in average global temperatures. It is caused by an increase in Greenhouse Gases in the Atmosphere

**Human activities that contribute to global warming or Causes of global warming.**

- ✓ Burning of fossil fuels/ petrol/ hydrocarbons/ wood/ coal etc.
- ✓ Deforestation/ cutting down trees or vegetation.
- ✓ Industrial activities or fumes from industries
- ✓ Bush or forest fires.
- ✓ Emission of exhaust fumes from cars.
- ✓ Cooking of food.
- ✓ Agricultural activities or breeding of cattle which produce methane.

**Effects of global warming**

- ✓ An increase in atmospheric temperature.
- ✓ The melting of icebergs.
- ✓ Less availability of freshwater bodies such as rivers, streams, lakes.
- ✓ Increase use of chemical fertilizers on crop lands.
- ✓ Wide spread extinction of species.
- ✓ Change in the ecosystem or climate.
- ✓ Massive crop failure.
- ✓ Increase in drought or fires.
- ✓ Rise in the sea level.

**Ways of minimizing global warming or possible factors to address the problem of global warming**

- ✓ Planting more trees.
- ✓ Encouraging the use of natural gas and liquefied petroleum gas.
- ✓ Recycling of plastic bags and containers.
- ✓ Changing light bulbs with compact fluorescent light.
- ✓ Purchases of energy efficiency products.
- ✓ Replacement of old appliances.

## STRAND 5: HUMANS AND THE ENVIRONMENT

## Sub-Strand 5: Understanding the Environment

**Content Standard: B7.5.5.1 Demonstrate understanding of different plants and animals found in different land forms and how they survive.**

**Environment** can be defined as a sum total of all the living and non-living elements and their effects that influence human life.
*The living or biotic elements are animals, plants, forests, fisheries, and birds.*
*The non-living or abiotic elements include water, land, sunlight, rocks, and air.*

***Landforms*** are defined as the natural physical features found on the surface of the earth created as a result of various forces of nature such as wind, water, ice, and movement of tectonic plates. Some landforms are created in a matter of few hours, while others take millions of years to appear. There are many types of landforms on the earth's surface.

**The following are some of the common types of landforms**:
A. Mountains b. Hills c. Plateaus d. Valleys e. Plains
F. Deserts g. Islands h. Rivers i. Oceans


**Mountains:** Elevated landforms with steep slopes and high peaks. Animals found in mountains include mountain goats, snow leopards, bears, and various bird species adapted to high-altitude environments. Plant life in mountains varies based on altitude and climate, with species such as coniferous trees, alpine flowers, and mosses.

**Hills**: Elevated areas with rounded tops, lower in height than mountains. Animals found in hills include deer, foxes, rabbits, and a variety of bird species. Plant life on hills can include grasses, shrubs, and deciduous trees.

**Plateaus:** Flat, elevated landforms with steep sides. Plateaus are home to animals such as wild goats, antelopes, wolves, and smaller mammals adapted to the plateau's unique conditions. Plant life on plateaus includes hardy grasses, shrubs, and some types of trees that can withstand the plateau's dry and rugged environment.

**Valleys:** Low-lying areas between hills or mountains. Valleys are habitats for animals such as deer, elk, bears, and various small mammals and bird species. Valleys support a variety of plant life including grasses, flowering plants, and trees along riverbanks.

**Plains:** Flat or gently rolling landforms. Plains support diverse animal life including bison, pronghorns, coyotes, and a wide variety of grassland birds. Plant life in plains includes grasslands with a variety of grass species and flowering plants.

**Deserts:** Dry, arid regions with sparse vegetation. Desert animals include camels, snakes, lizards, scorpions, and various small mammals adapted to survive in extreme heat and limited water resources. Desert plants are often drought-resistant such as cacti, succulents, and shrubs.

**Islands:** Landmasses surrounded by water. Island animals can include unique species such as lemurs (in Madagascar), iguanas (in the Galápagos), seabirds like puffins (in northern islands), and marine life specific to the surrounding waters. Island plant life varies but often includes unique endemic species adapted to island conditions.

**Rivers:** Water bodies that flow through the landscape. Animals found around rivers include fish species, otters, beavers, birds like herons and kingfishers, and various reptiles and amphibians. Plant life around rivers includes aquatic plants like water lilies as well as trees and shrubs along the riverbanks.

**Oceans:** Vast bodies of saltwater. Ocean habitats support a wide range of marine life including fish of all sizes, whales, dolphins, sharks, sea turtles, and countless other aquatic species. Ocean plant life includes algae, seaweed, and various types of sea grasses.

**Delta**: Landforms formed at the mouth of a river where it meets a body of water such as an ocean or sea. Deltas provide habitats for diverse aquatic animals including fish species adapted to brackish water conditions along with bird species that feed on aquatic life near the delta. Plant life in deltas includes wetland vegetation such as mangroves and other salt-tolerant plants**.**

**Importance of landforms**

1. Habitat: Landforms provide habitats for various plants and animals. Different landforms support different ecosystems, which contribute to biodiversity and the overall health of the planet.
2. Water Resources: Landforms such as mountains and valleys play a crucial role in the water cycle. Mountains capture moisture from the atmosphere, which then flows down as rivers and streams, providing freshwater for drinking, irrigation, and other human needs.
3. Agriculture: Different landforms have different soil types and fertility levels, which can affect agricultural productivity. Plains and valleys often have fertile soil that is suitable for farming, while mountains and plateaus may have more challenging conditions.
4. Recreation and Tourism: Landforms such as mountains, canyons, and islands attract tourists and provide opportunities for recreational activities like hiking, skiing, and water sports. These activities contribute to local economies and provide enjoyment for people.
5. Geological Resources: Landforms can contain valuable geological resources such as minerals, fossil fuels, and precious metals. These resources are essential for various industries and contribute to economic development.
6. Natural Protection: Landforms like hills and mountains can act as natural barriers, protecting areas from extreme weather events like hurricanes or tsunamis. They can also help regulate climate patterns and prevent erosion.

**Human activities that can affect landforms:**

1. Mining: Mining activities, such as open-pit mining or underground mining, can result in the removal of large amounts of soil and rock, altering the shape and composition of landforms.
2. Deforestation: Clearing forests for agriculture, logging, or urban development can lead to soil erosion, which can change the structure and stability of landforms.
3. Construction: Building infrastructure like roads, buildings, and dams can involve excavation, filling, and grading of land, which can modify the natural landforms in the area.

4. Bad agricultural farming: Intensive farming practices, such as excessive irrigation or improper land management, can cause soil erosion and degradation, impacting the shape and fertility of landforms.
5. Landfills: The disposal of waste in landfills can result in the alteration of landforms, as large amounts of soil and rock are often excavated and reshaped to accommodate the waste.

**Adaptation** refers to the process by which living organisms adjust to their environment in order to survive and thrive. It involves changes in an organism's behavior, physiology, or structure that allow it to better suit its surroundings and increase its chances of survival.
Adaptation can occur in response to various factors, such as changes in temperature, availability of food, or presence of predators. It is an essential mechanism for species to ensure their survival and successful reproduction in different environments

**Adaptations of Aquatic Habitats Plants:**
I. These plants have long, narrow stems. This prevents the plants from being carried away with the water current.
Ii. Stems have air chambers that allow the aquatic plants to float in water leaves of plants such as lotus and water lily have a waxy coating that prevents them from rotting.
**Animals:**
I. Ducks have webbed feet that help them in swimming. They also have hollow bones that help them to stay afloat.
Ii. Gills are special organs that help fish to breath underwater.
Iii. They have streamlined body which allows them to swim fast by reducing resistance due to flowing water.
Iv. Dolphins and whale have blowholes at the upper parts of their heads. They come to the water surface and breathe in air through the blowholes from time to time.

**Adaptation of Forest habitat Plants:**
The following adaptation is shown by rainforest plants: Leaves of tropical rainforest trees have specialized tips. Due to the dense vegetation of rainforest, very little light is able to reach the forest floor. Plants growing in lower levels have big leaves to absorb as much sunlight as possible.
**Animals:**
There is a huge variety of animals in rain forests. Many animals have adapted by learning to eat a particular food, which is eaten by no other animals.

**Adaptation of Boreal Forests Plants:**
Trees have a conical shape that allows the snow to slide off easily.
Ii. Trees have needle-like leaves.
This kind of structure protects the leaves from damage.
**Animals:**
I. Many animals migrate to warmer regions during winter. Some animals hibernate during winter months
Ii. Some animals have a thick layer of fur or feather to protect them from cold.

**Adaptation of Grasslands Plants:**
I. Grassland plants usually have flexible stems that bend instead of breaking when the wind is strong.
Ii. Plants have strong roots that prevent winds from uprooting them.
Iii. Plants have narrow or tiny leaves to reduce water loss.
Iv. Some plants have roots that extend deep into the soil to absorb as much water as possible.
**Animals:**
I. Most grassland animals are able to run very fast. This ability also protects them grassland fire.

Ii. Many grassland animals have skin shades of brown that makes them hard to spot among the dry, brown grass.

**Adaptation of Deserts habitats Plants:**

I. The leaves are modified as spines to minimize water loss.
Ii. The stem is green, to make food for the plant.
Iii. The stem is swollen and fleshy to store water.
Iv. Cactus plant has a thick, waxy coating that prevents water loss and helps it to retain water

**Animals:**

I. Desert animals have thick skin to prevent the loss of water from the body
Ii. Most of the desert animals have the capacity to store water and food. For example, a camel can tolerate extremely hot temperature due to the stored water in its body, which helps in cooling.
Iii. Most of the small desert animals live in burrows to save themselves from fluctuation in temperature.
Iv. Reptiles are well-suited to the desert climates. They get most of the water through their food and lose hardly any moisture from their skin.

**Interactions Between Organisms**

Biotic interactions are interactions between living organisms. There are several types of biotic interactions, including:

**1. Predation:** This is when one organism, called the predator, hunts and feeds on another organism, called the prey. For example, a lion hunting and feeding on a zebra.

**2. Mutualism**: This is a type of interaction where both organisms benefit from each other. An example of mutualism is the relationship between bees and flowers. Bees collect nectar from flowers for food, while they help in pollination, allowing the flowers to reproduce.

**3. Commensalism**: This is a relationship where one organism benefits, while the other is neither harmed nor benefited. An example of commensalism is the relationship between cattle egrets and cattle. The egrets feed on insects that are disturbed by the cattle while grazing, without causing any harm to the cattle.

**4. Parasitism:** This is a relationship where one organism, called the parasite, benefits at the expense of the other organism, called the host. An example of parasitism is the relationship between ticks and mammals. Ticks feed on the blood of mammals, causing harm and potential diseases to the host.

**5. Competition:** This is when two or more organisms compete for the same limited resources, such as food, water, or territory. An example of competition is the competition between lions and hyenas for prey in the same ecosystem.

**Importance of the interaction among living organism**

1. Promotes biodiversity
2. Facilitates nutrient cycling
3. Supports ecosystem stability
4. Enables symbiotic relationships
5. Enhances ecological resilience
6. Influences population dynamics
7. Affects energy flow in ecosystems
8. Contributes to evolutionary processes
9. Supports food webs and chains
10. Influences ecosystem services

**Negative effects of the interaction among organisms**:

1. Competition for resources
2. Predation and herbivores
3. Disease transmission
4. It leads to parasitism
5. Invasive species
6. Overpopulation and overcrowding
7. Disruption of ecological balance
8. Habitat destruction

## BASIC 8

## STRAND 1: DIVERSITY OF MATTER

## SUB-STRAND 1: MATERIALS

### B8.1.1.1.1 Identify types of mixtures by name and characteristics

**Materials/matter** exits and can be found in three [3] forms. These are; Solids, Liquids and Gases. Apart from these three [3] common forms of matter, a fourth state/type/form of material/matter called plasma has been found to exist. Note: Plasma is super- heated matter or ionized gas.

**Mixtures**

**A mixture** is the substance formed by the physical combination of two or more substances.
A mixture is created/formed by the combination of two [2] or more different substances/materials together by a physical/reversible process

**Mixtures are classified under the following types**;

1. **Solid – Liquid mixture:** A solid - liquid mixture is a type of mixture that is formed from the physical combination of a solid substance and a liquid substance that have been put together. The solid may or may not dissolve in the liquid. E.g. Sugar and water, Gari and water etc.
2. **Solid – Gas mixture**: A solid - gas mixture is a type of mixture that is formed from the physical combination of a solid substance and a gaseous substance that have been put together. E.g. Smoke, dust.
3. **Solid – solid mixture**: These are alloys when the solids are metals. E.g. Bronze (copper and tin), Steel (iron and carbon), Brass (copper and zinc) etc.
4. **Gas – liquid mixture**. A gas - liquid mixture is a type of mixture that is formed from the physical combination of a gaseous substance and a liquid substance that has been put together. E.g. Fog (water droplets mixed with air).
5. **Gas – gas mixture**, A gas - gas mixture is a type of mixture that is formed from the physical combination of two [2] or more gaseous substances that have been put together. E.g. Air.
6. **Liquid – liquid mixture**. A liquid - liquid mixture is a type of mixture that is formed from the physical combination of two [2] or more liquid substances together. E.g. Alcoholic drinks, cough mixtures, crude oil.

**Types of mixtures**

**There are two [2] main types of mixtures.**

These are;
1. Homogeneous mixture;
2. Heterogeneous mixture.

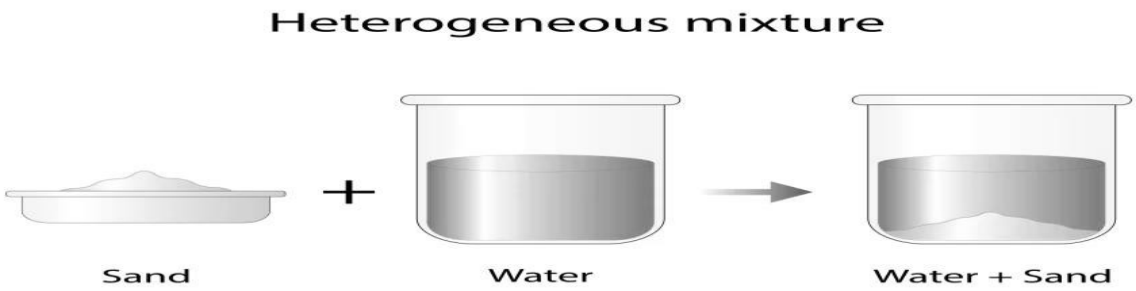
**1. Homogeneous [uniform] mixture**

**A homogeneous mixture** is a type of mixture in which the different substances; i.e. Components of the mixture, mixes up completely together in such a way that the two substances are seen/appear as one. In a homogeneous mixture, the mixture composition is **uniform**; i.e. The same throughout the mixture.


**Examples of homogeneous mixture includes;** a mixture of salt and water [salt solution], a mixture of sugar and water [sugar solution], a mixture of different non-harmful gases [air], a mixture of alcohol and water [diluted alcohol], a mixture of different metals [alloy], wine, shampoo, vinegar, smog, etc.

## 2. Heterogeneous [non-uniform] mixture

A heterogeneous mixture is a type of mixture in which the different components; i.e. Materials of the mixture do not mix up completely together but are easily found/seen to be made of different; i.e. Two or more parts/phases. In a heterogeneous mixture, the composition is not uniform throughout the mixture.




**Examples of heterogeneous [nonuniform] mixture includes;** a mixture of oil and water, ice in water, salt and oil, sand and water [muddy water], etc.
In addition to the above, there are some types of mixtures that appear homogeneous from a distance but are actually heterogeneous from a closer look [inspection]. Such mixtures include; blood and soil.

| Homogeneous mixtures | Heterogeneous mixtures |
|---|---|
| 1. Homogeneous mixtures have a uniform Composition throughout, | Heterogeneous mixtures have visibly different components. |
| 2. Homogeneous mixtures have Particles that are evenly distributed, That are distributed. | Heterogeneous mixtures have particles That are not distributed. |
| 3. Homogeneous mixtures have a single phase | Heterogeneous mixtures have multiple phases. |
| 4. Homogeneous mixtures are difficult to Separate, | Heterogeneous mixtures can be easily separated. |

**Why air is considered as a mixture**

- Its constituents can easily be separated by physical means.
- It has no definite molecular formula.
- The proportions of gases in it vary from place to place or it has variable composition.
- Its components retain their individual properties.

**Solution, solute and solvent**

**Solution:** It is a homogeneous or uniform mixture of a solute ad solvent.
**Solute:** It is the substance that dissolves in a solvent.
**Solvent:** It is the substance that dissolves the solute and it is usually a liquid.
**Note:** The solute can be a solid, liquid, or a gas. If the solute is a liquid, then in the solution, the substance with the smaller volume is the solute.

**Solutes and their solvents:**

1. Salt (solute) in water (solvent)
2. Sugar (solute) in water (solvent)
3. Ethanol (solute) in water (solvent)
4. Carbon dioxide (solute) in water (solvent)

5. Oxygen (solute) in blood (solvent)
6. Nitrogen (solute) in air (solvent)
7. Acetic acid (solute) in water (solvent)
8. Ink - The solvent for ink can vary depending on the type of ink, but it is commonly a mixture of water and organic solvents such as ethanol or glycol ethers..
9. Glue - The solvent for glue can vary depending on the type of glue. Common solvents for glue include water, acetone, or ethyl acetate.
10. Chlorophyll - Chlorophyll is typically found in plants and is soluble in organic solvents such as ethanol or acetone.
11. Blood - The primary solvent in blood is water, but it also contains various dissolved substances such as proteins, ions, and gases.
12. Soil - Soil is a complex mixture of organic and inorganic substances, and its solvent properties can vary depending on the composition. Water is often considered the main solvent in soil

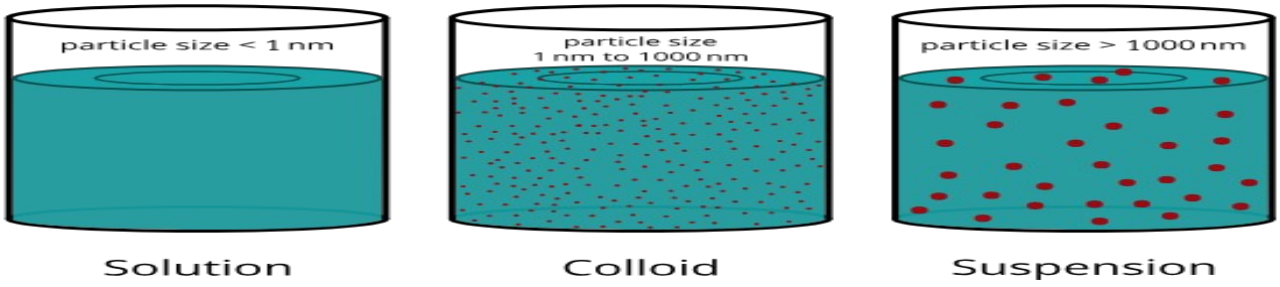
**Forms of solution**

- **Aqueous solution:** It is a solution whose solvent is water.
- **Saturated solution:** It is a solution in which the solvent can no longer dissolve any more of the solute, at a given temperature in the presence of excess of the solute.
- **Unsaturated solution:** It is a solution in which the solvent can dissolve more of the solute at a given temperature.
- **Standard solution:** It is a solution whose concentration is accurately known

**A suspension** is a type of a solid - liquid mixture in which the solid components [solute] does not dissolve completely in the liquid component [solvent].
A suspension is also a **heterogenous solid - liquid mixture because the solvent does not completely dissolve the solute.**
In suspension, the particles are too big enough to be seen with our naked eye.
Examples suspensions includes;

- A mixture of sand and water,
- A mixture of powdered chalk and water,
- A mixture of groundnut paste and water,
- Mixture of groundnut paste and water in a glass etc.

**Colloid** is a mixture of solute and solvent in which the solute particles are permanently suspended. In colloid the particles are too small to be seen but are enough to reflect light. Examples are, cooked starch, blood, glue, toothpaste, fog,milk etc.




**Miscible liquids** are liquids that are capable of mixing together in all proportions to form a homogeneous solution.

**Examples of miscible liquids**

A. Water and alcohol
**b.** Benzene and methyl benzene
C. Methanol and ethanol
**d.** Oil and alcohol.

**Immiscible liquids** are liquids that are not capable of mixing together to form a homogeneous solution. Instead, they form separate layers or droplets when mixed. An example of immiscible liquids is oil and water.

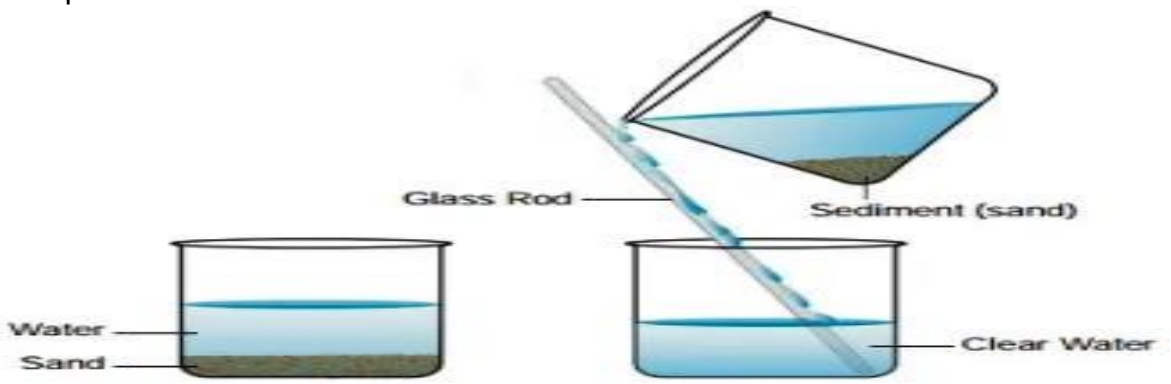
**Examples of immiscible liquids**

**a.** Water and kerosene b. Oil and water c. Water and benzene d. Water and carbon tetrachloride.

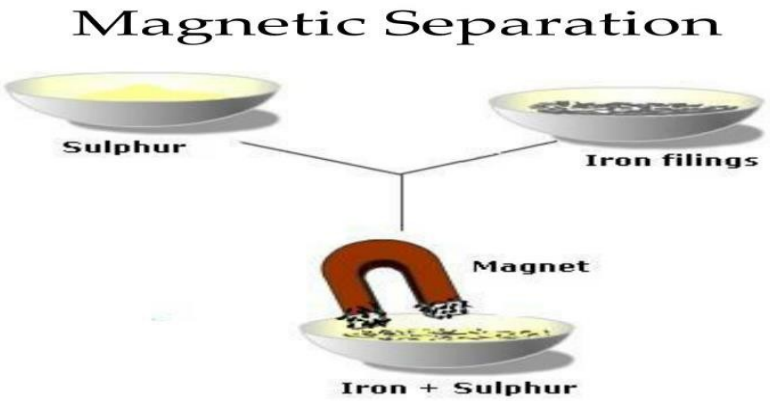
## B8.1.1.1.2 Design and Perform processes for separating kinds of mixtures

### Methods of separating mixtures

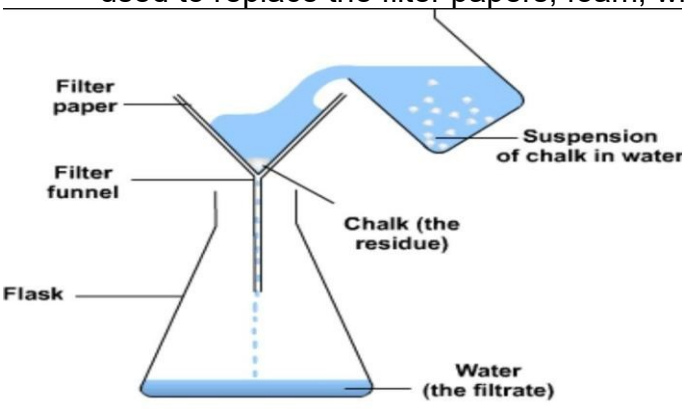
1. **Decantation**: Can be used to obtain an insoluble solid from a suspension. E.g. A mixture of powered chalk and water.

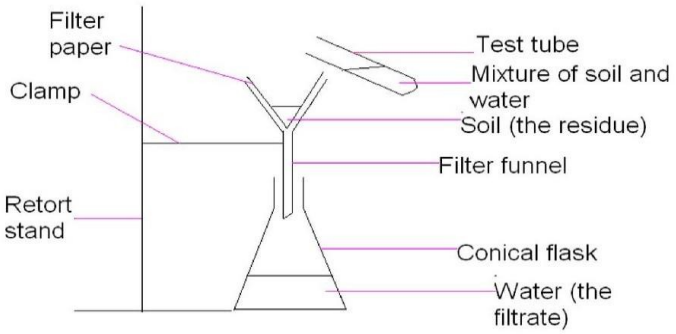



2. **Use of Magnets**: Can be used to obtain a magnetic solid from non – magnetic solids. E.g. Mixture of iron filings and dust/sand

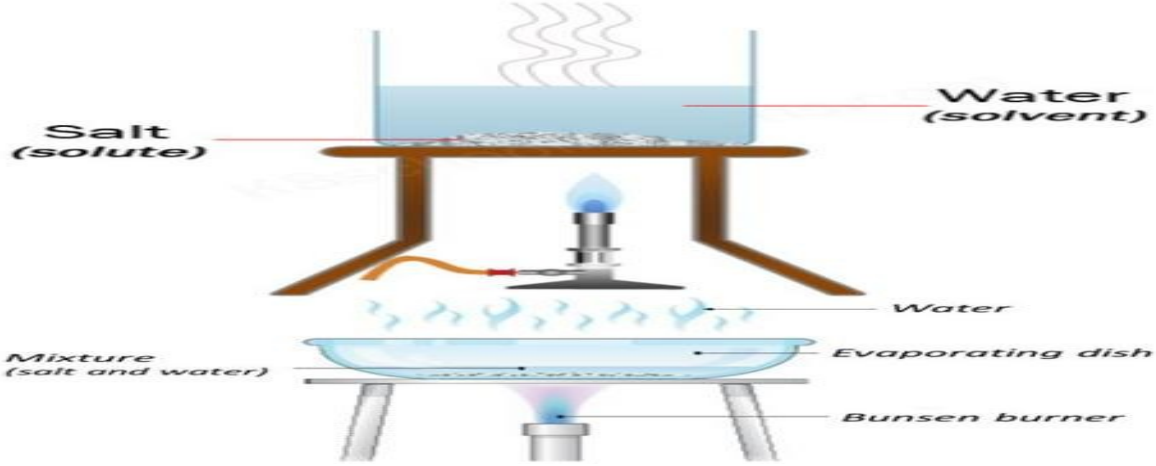



3. **Filtration:** Can be used to obtain insoluble solid from a suspension. This method is more preferred to decantation. The filtration method is a process used to separate solids from liquids or gases by passing the mixture through a filter. The filter allows the liquid or gas to pass through while trapping the solid particles. The following are other materials that can be used to replace the filter papers, foam, white cloth, cotton etc.



4. **Evaporation**: Can be used to obtain a soluble solid from a solution. E.g. Salt solution, sugar solution. **Note**: In this method, the solvent (liquid) is lost.



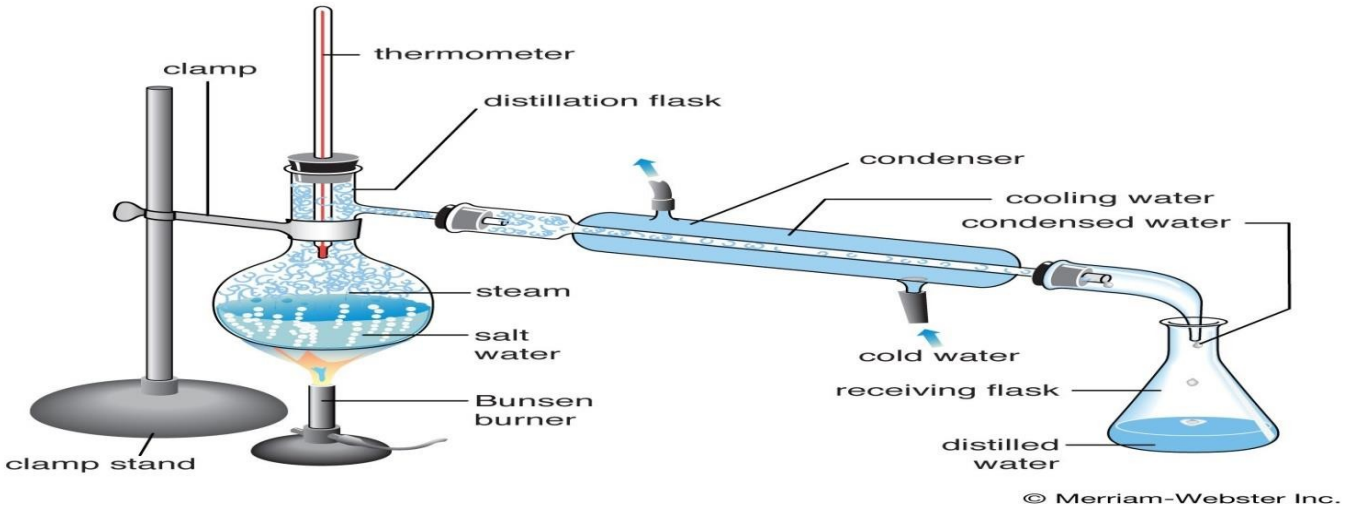

5. **Distillation:** Can be used to obtain a solvent from solution. **Note**: In this method, both the solvent (liquid) and the solute (solid) are collected.

Here are three additional processes that are commonly used in distillation:

1. Condensation: This process involves cooling the vapor produced during distillation, causing it to condense back into a liquid state. This allows for the separation of the desired component from the mixture.
2. Evaporation: In distillation, evaporation is used to convert the liquid mixture into vapor by heating it. This vapor contains the components with lower boiling points, which can then be separated from the mixture.
3. Boiling is a process in which a liquid changes into a vapor state when heated to its boiling point. During boiling, the liquid molecules gain enough energy to overcome the forces holding them together, resulting in the formation of bubbles and the release of vapor.

**Mixtures that can be separated by method of distillation**

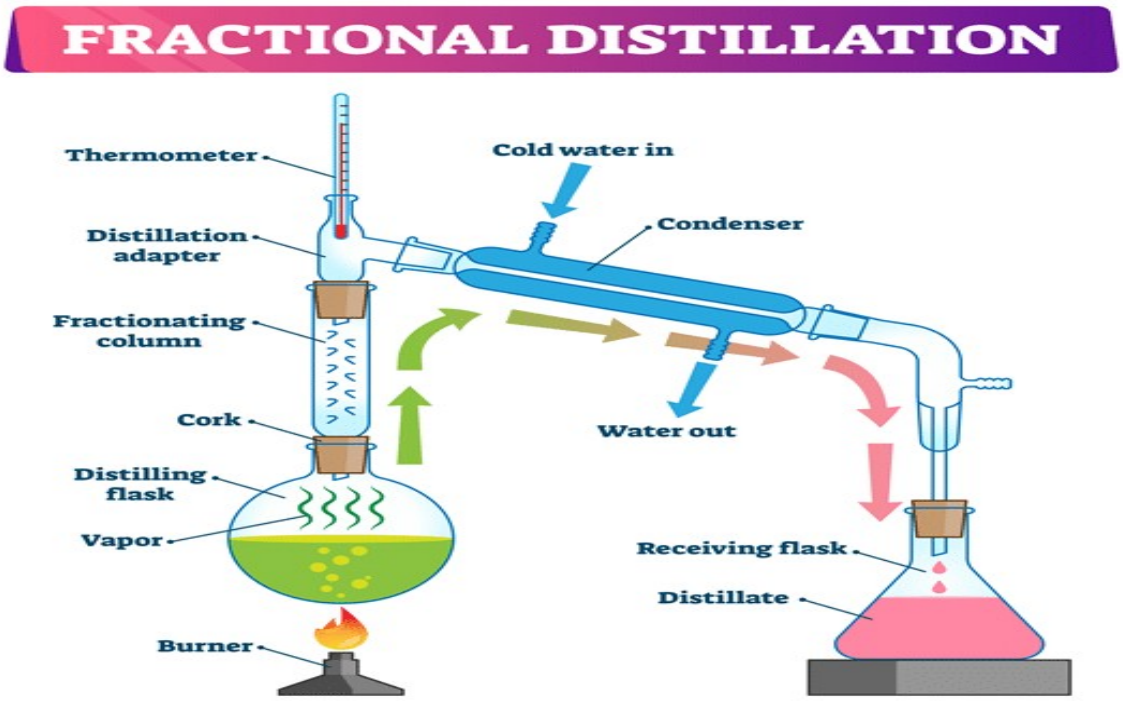
A. Akpeteshie **b.** Palm wine Local gin **c.** Crude oil, d. Alcohol and muddy water.



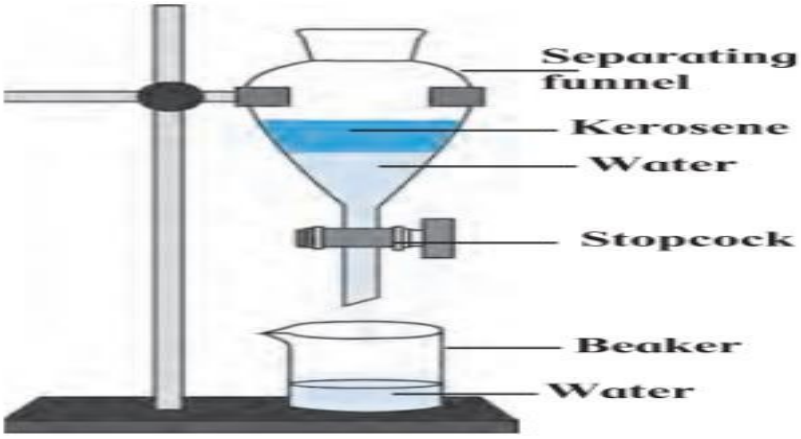

6. **Fractional Distillation**: Can be used to obtain a liquid from a mixture of liquids with different but close boiling points. E.g. Alcohol and water. **Note**: Boiling points of alcohol and water are 78 and 100 respectively.

**Products that can be obtained during fractional distillation of crude oil**

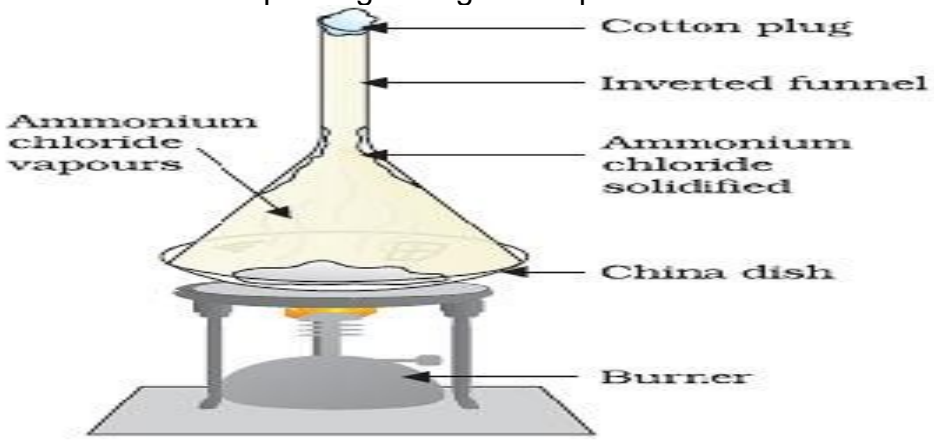
a. Gas oil **b.** Bitumen **c.** Diesel **d.** Lubricating oil




7. **Use of separating funnel:** Can be used to obtain a liquid from two liquids that do not mix. Example, liquids like palm oil and water do not mix. They are said to be immiscible. They form emulsions. Also, Kerosene and water do not mix.




8. **Sublimation:** It is the process by which a solid particle changes directly into the gaseous state without passing through the liquid state.



This method can be used to obtain a solid that sublimes from a solid that does not sublime when the mixture is heated. E.g. Sodium chloride and ammonium chloride.
**Note:** Examples of substances that sublime is camphor, naphthalene, ammonium chloride, iodine crystals.

**Separating of a mixture of granular sugar and sand**

- Add water to the mixture and air to dissolve the sugar.
- Filter the mixture to collect the sugar solution as filtrate and the sand as residue.
- Crystallize the filtrate to collect the sugar or evaporate the filtrate to saturate it.
- Cool the water to collect the sugar.

**How to obtain a pure sample of sodium chloride from a mixture of sodium chloride and sand**

- Water id added to the mixture of sodium chloride and sand.
- This is stirred to dissolved the sodium chloride.
- The sand is filtered off.
- Filtrate is evaporated to dryness.
- The salt is crystallized and collected dry.

**Separation of a mixture of iron filings and sand**

- Put the mixture in a test tube or beaker.
- Use magnet to attract the iron filings from the mixture.
- The sand is left at the bottom of the container.
- This method is called **magnetic separation.**

**Separation of a mixture of crystals of iodine and charcoal**

- Put the mixture in evaporating dish or test tube or beaker.
- Cover beaker or test tube with a watch glass or filter paper or inverted funnel.
- Heat gently over a low flame or using the sun.
- Iodine vapourises or sublimes after sometimes.
- Deposit of iodine is seen on the watch glass or filter paper or top of the test tube.
- Heating is continued until no violet vapour is seen to be coming from the mixture.
- The charcoal is left at the bottom of the container.
- This method is called **sublimation.**

**Mixtures that can be separated by method of filtration**

- Water and sand
- Water and powdered chalk crystals in saturated solution.

**Mixtures that can be separated by method of sublimation**

- Iodine crystals and sand
- Ammonium chloride and any named solid, which does not sublime.
- Naphthalene and any named solid, which does not sublime.

**Mixtures that can be separated by method of separating funnel**

- Water and palm oil. **Note:** The separating funnel is used to separate two immiscible liquids.

**Mixtures that can be separated by method of Chromatography**

Ink, dye, urine, flower extracts, blood.

- **Chromatography** is used to separate a mixture of solutes by using their different rates of movement over a porous medium.

**B8.1.2.2.1 Describe atoms as composed of subatomic particles**
**B8.1.2.2.2 Explain the arrangement of elements in terms of the number of protons in the nuclei of atoms of each element**

## ELEMENT

In chemistry, **the five basic units of matter** are *atoms, molecules, ions, elements, and compounds.*

- **Atoms:** The smallest particle of a substance that can take part in a chemical reaction.
  **Examples** are Hydrogen (H), Oxygen (O), Sodium (Na).
- **Molecules**: They are group of atoms that are chemically combined and can exist on their own. Examples are $H_2$ , $O_2$ , $CO_2$.
- **Ions**: They are electrically charged atoms. $Na^+$ , $O^{2-}$, $Cl^-$ etc.

## Elements, Compounds and Mixtures

**An element** is a substance that is made up of the same kind of atoms and cannot be broken down into simpler substances by unknown chemical means.

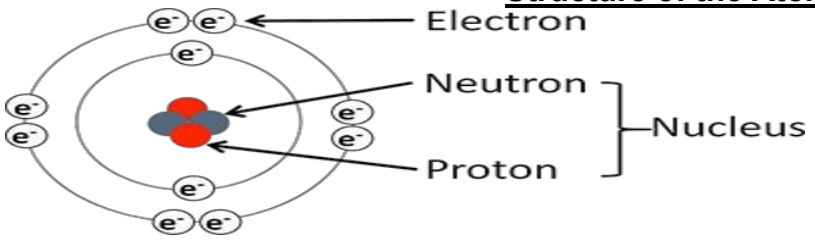
**Examples**

| Element | Chemical symbol | Atomic number | |
|---|---|---|---|
| Hydrogen | H | 1 | Hello |
| Helium | He | 2 | Hello |
| Lithium | Li | 3 | Listen |
| Beryllium | Be | 4 | B |
| Boron | B | 5 | B |
| Carbon | C | 6 | C |
| Nitrogen | N | 7 | News |
| Oxygen | O | 8 | On |
| Fluorine | F | 9 | Friday |
| Neon | Ne | 10 | Night |
| Sodium | Na | 11 | Some |
| Magnesium | Mg | 12 | Ministers |
| Aluminium | Al | 13 | Are |
| Silicon | Si | 14 | Selling |
| Phosphorus | P | 15 | Pito |
| Sulphur | S | 16 | So |
| Chlorine | Cl | 17 | Contact |
| Argon | Ar | 18 | Araba |
| Potassium | K | 19 | Pito |
| Calcium | Ca | 20 | Centre |

| ELEMENT | CHEMICAL SYMBOL |
|---|---|
| 1. Gold: | Au |
| 2. Silver: | Ag |
| 3. Mercury: | Hg |
| 4. Iron | Fe |
| 5. Manganes | Mn |
| 6. Zinc: | Zn |
| 7. Lead: | Pb |

| | |
|---|---|
| 8. Tin: | Sn |
| 9. Copper: | Cu |

## Structure of the Atom




## The Atomic Structure

- The atom is made up of three fundamental or sub-atomic particles namely: protons, neutrons and electrons.
- Protons are positively charged; electrons are negatively charged while neutrons have no charge (i.e. Neutral).
- The protons and neutrons are found in the nucleus of the atom while electrons are found around the shells of the atom.
- Protons and neutrons have a relative mass of 1a.m.u (atomic mass unit) and electrons have ___
- The nucleus occupies the central part of the atom.

## Summary of the sub-atomic particles

| **Sub-atomic particle** | **Charge** | **Mass** | **Location in the atom** |
|---|---|---|---|
| Proton | Positive (+) | 1 a.m.u | Inside the nucleus |
| Neutron | Neutral (0) | 1 a.m.u | Inside the nucleus |
| Electron | Negative (-) | ____ | Around the shells of the nucleus |

## Differences between protons and electrons

| **Protons** | **Electrons** |
|---|---|
| 1. They have positive charge. | 1. They have negative charge. |
| 2. They are located in the nucleus of the atom. | 2. They are located outside the nucleus in orbits. |
| 3. They have relative mass of 1 a.m.u. | 3. They have negligible relative mass. |
| 4. They are fixed and stationary in the atom. | 4. They are mobile in the atom. |

## Arrangement of Electrons in Atoms

Electrons are arranged in the shells of an atom. Therefore, the arrangement of electrons in the shells of an atom is called electron configuration.

### Shells of an Atom

- K-Shell ……. 1st shell.
- L-Shell …….2nd shell
- M-Shell …… 3rd shell
- N-Shell …… 4th shell

### Representation of Shells in Electron Configuration

| Type of shell | Maximum number of electrons contained |
|---|---|
| K-Shell | 2 |
| L-Shell | 8 |
| M-Shell | 8 |
| N-Shell | 8 |

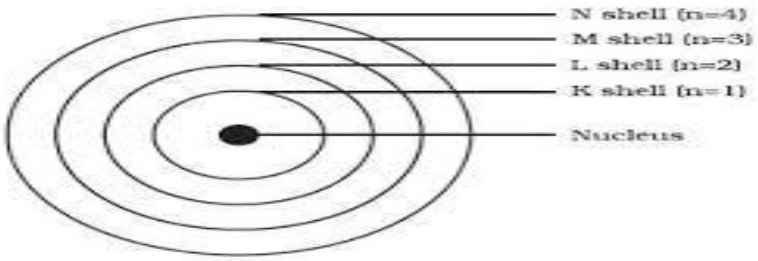
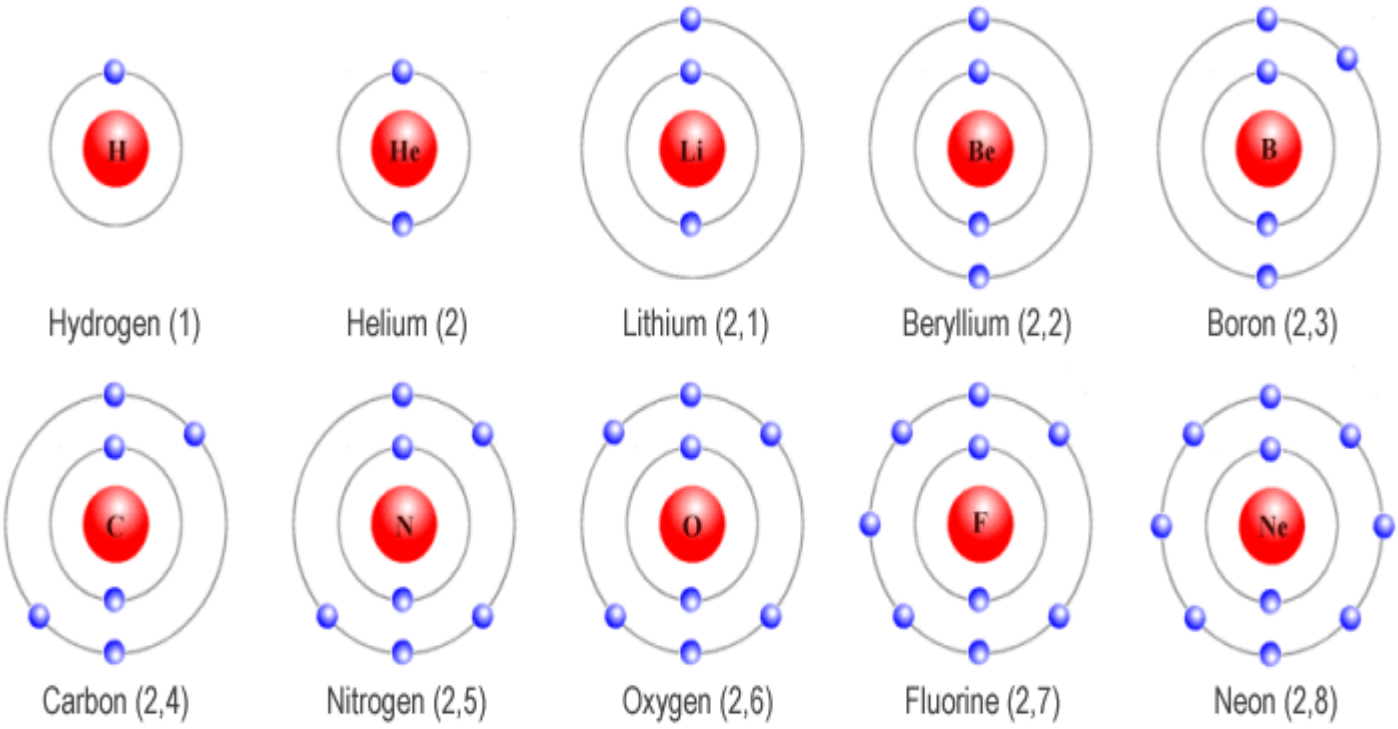



*Fig. 4.3: A few energy levels in an atom*




**Note:** The total number of electrons a shell can contain is given by the formula 2 , where n is the shell number (i.e. 1, 2, 3, or 4).

**The electron configuration of an element** describes how electrons are distributed in its atomic orbitals or shells.

| ATOMIC NUMBER | PHRASE | ELEMENT | SYMBOL | ELECTRONIC CONFIGURATION |
|---|---|---|---|---|
| 1 | Hi | Hydrogen | H | 1 |
| 2 | Hello | Helium | He | 2 |
| 3 | Listen | Lithium | Li | 2,1 |
| 4 | B | Beryllium | Be | 2,2 |
| 5 | B | Boron | B | 2,3 |
| 6 | C | Carbon | C | 2,4 |
| 7 | News | Nitrogen | N | 2,5 |
| 8 | O | Oxygen | O | 2,6 |
| 9 | F | Flourine | F | 2,7 |
| 10 | NewZealand | Neon | Ne | 2,8 |
| 11 | Nagaland | Sodium | Na | 2,8,1 |
| 12 | Meghalya | Magnesium | Mg | 2,8,2 |
| 13 | All | Aluminium | Al | 2,8,3 |
| 14 | Senior | Silicon | Si | 2,8,4 |
| 15 | Public | Phosphorus | P | 2,8,5 |
| 16 | Schools | Sulphur | S | 2,8,6 |
| 17 | Closed | Chlorine | Cl | 2,8,7 |
| 18 | Around | Argon | Ar | 2,8,8 |
| 19 | Kargil | Potassium | K | 2,8,8,1 |
| 20 | C.A. | Calcium | Ca | 2,8,8,2 |

## Terms Associated with the Atom

**a. Atomic number / proton number (Z):** The number of protons in a given atom.
Note: in a neutral atom, proton number equals electron number.

**b. Neutron number (n):** The number of neutrons in a given atom.

**c. Mass number (A):** The total number of protons and neutrons in a given atom.
**I.e. A = Z + n**

**d. Electron number (e):** The number of electrons in a given atom.

**e. Nuclide:** It is an atom with a specified or known atomic number and mass number.

**The main differences between atomic number and mass number are as follows:**
1. **Atomic number**: The atomic number of an atom represents the number of protons in its nucleus. It is denoted by the symbol "Z" and determines the element's identity. In a neutral atom, the atomic number also represents the number of electrons.
2. **Mass number**: The mass number of an atom represents the total number of protons and neutrons in its nucleus. It is denoted by the symbol "A" and is used to calculate the atomic mass of an element. The mass number can vary for different isotopes of the same element.

## Differences between atomic number and mass number

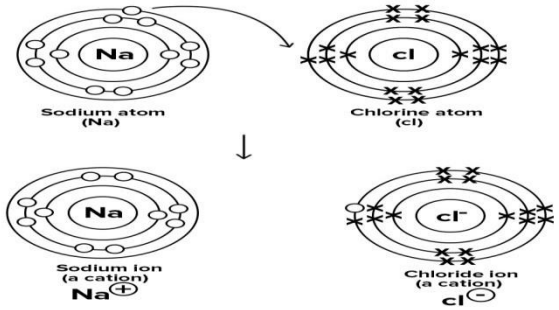
| **Atomic number**: | **Mass number**: |
|---|---|
| The atomic number determines the element's identity and is equal to the number of protons | The mass number represents the total number of protons and neutrons in the nucleus. |

## Representation of nuclide

, where
X or Y is any atom/ element;
A is mass number and
Z is atomic / proton number.

## Formation of Ions

**An ion** is a charged atom. An ion is formed by the atom of an element when it either gains or loses an electron or some electrons.
An electrically charged atom is either deficient or sufficient in electrons. An atom that has equal number of protons and electrons is said to be neutral.
***Ions are formed when neutral atoms either gain or lose electrons. When a neutral atom loses an electron, the total number of electrons decreases while the number of protons remains constant. As a result, the number of protons exceeds the number of electrons, hence the net charge on the atom becomes positive giving rise to formation of positive ions called cations. On the other hand, when a neutral atom gains an electron, the total number of electrons increases while the number of protons remains the same. As a result, the number of electrons exceeds the number of protons. Hence the net charge on the atom becomes negative giving rise to formation of negative ions called anions.***

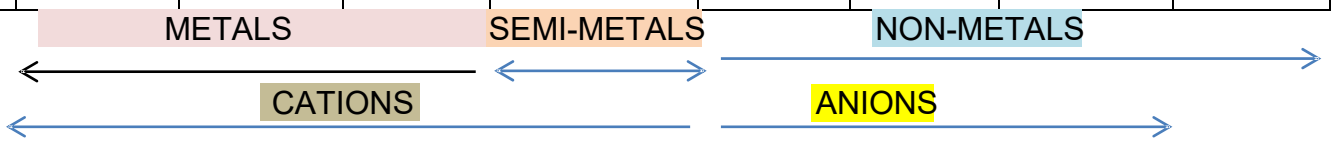




## Types of Ions

1. **Cations**: They are positively charged ions. E.g. L , N , , M , C , A .
2. **Anions**: They are negatively charged ions. E.g. C , ,

**Periodic table** is the arrangement of elements according to their increasing atomic numbers. On the periodic table elements with similar properties are placed in vertical rows (called period) and horizontal columns (called group).

| | GROUP 1 | GROUP 2 | GROUP 3 | GROUP 4 | GROUP 5 | GROUP 6 | GROUP 7 | GROUP 8 |
|---|---|---|---|---|---|---|---|---|
| PERIOD 1 | 1 H | | | | | | | 2 He |
| PERIOD 2 | 3 Li | 4 Be | 5 B | 6 C | 7 N | 8 O | 9 F | 10 Ne |
| PERIOD 3 | 11 Na | 12 Mg | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| PERIOD 4 | 19 K | 20 Ca | | | | | | |
| | Alkali metals | Alkaline earth metals | | | | | Halogens | Noble gas |
| Charges | +1 | +2 | +3 | +4 | -3 | -2 | -1 | 0 |
| Valency | 1 | 2 | 3 | 4 | 3 | 2 | 1 | 0 |




The above periodic table would HELP you identify the **cations and anion** easily.

**Work examples**

1. The atomic number of an element is 19 and its mass number is 39. Find the number of the following;
   (i) Protons; ii. Electrons; iii. Neutrons; iv. Name the element.

**Solution**

(i) 19 protons
(ii) 19 electrons
(iii) $A = Z + n \Rightarrow n = A - Z = 39 - 19 = 20$ neutrons
(iv) Potassium.

2. An atom has 6 protons and 7 neutrons in its nucleus. Find the following for the atom:
   (i) Mass number;
   (ii) Number of electrons

**Solution**

(i) 6 + 7 =13
(ii) 6

3. Find the values of the letters in the table below.

| Isotope | Atomic number | Number of neutrons | Mass number |
|---|---|---|---|
| (i) | R | S | T |
| (ii) | 19 | 10 | W |
| (iii) | 16 | Z | 32 |

**Solution**

(i) R = 17; s = 37 – 17 = 20; t = 37
(ii) U = 19 + 10 = 29; v = 19; w = 29
(iii) X = 32; y = 16; z = 32 – 16 = 16

4. Consider the isotope Of Sulphur and state the number of
   (i) Protons;

(ii) Electrons;
(iii) Neutrons, in its -2 ionic state.

**Solution**

(i) 16
(ii) 16 + 2 =18 (Note: Sulphur has gained two more electrons in its ionic state).
(iii) 33 – 16 = 17

5. Consider the +3 ionic state of the nuclide And write down the proton, neutron and electron numbers.

**Solution**

Proton number = 13
Neutron number = 27 – 13 = 14
Electron number = 13 – 3 = 10 (note: Al has lost three electrons).

6. Study the table below and use it to answer the questions that follow.

| Atom / Element | Atomic number | Mass number |
|---|---|---|
| **V** | 10 | 18 |
| **W** | 18 | 39 |
| **X** | 15 | 33 |
| **Y** | 10 | 20 |
| **Z** | 11 | 23 |

(i) How many neutrons are there in atom X?
(ii) Which of the atoms will readily form an ion?
(iii) Which of the atoms will form an ion with a positive charge of +3?
(iv) $\alpha$ Indicate the atoms that are isotopes.
$\beta$ Explain your answer in $\alpha$ above.

**Solution**

(i) 33 – 15 = 18 neutrons
(ii) Atom Z (Note: atom Z is sodium and its ion is N ).
(iii) None of the atoms.
(iv) $\alpha$ Atoms V and Y.
$\beta$ The atoms have the same atomic numbers but different mass numbers.

**Molecule**

**A molecule** *is a group of atoms that are chemically bonded together.* It is the smallest unit of a chemical compound that retains the chemical properties of that compound. .

Here are examples of molecules
1. Water ($H_2O$) - This molecule consists of two hydrogen atoms bonded to one oxygen atom.
2. Carbon dioxide ($CO_2$) - This molecule consists of one carbon atom bonded to two oxygen atoms.
3. Methane ($CH_4$) - This molecule consists of one carbon atom bonded to four hydrogen atoms.
4. Ammonia ($NH_3$) - This molecule consists of one nitrogen atom bonded to three hydrogen atoms.
5. Hydrogen peroxide ($H_2O_2$)
6. Hydrogen ($H_2$),
7. Oxygen ($O_2$),
8. Chlorine ($Cl_2$),
9. Nitrogen ($N_2$)
10 Ozone ($O_3$),

## STRAND 1: DIVERSITY OF MATTER
## SUB-STRAND 2: LIVING CELLS

**B8.1.2.1.1 Examine and describe the structure of prokaryotic and eukaryotic cells**
**B8.1.2.1.2 Classify organisms (plants or animals) as prokaryotic or eukaryotic based on the type of cells they are made of.**

### LIVING CELLS

Since 1665; when Robert Hook discovered the presence of the cell; i.e. The basic functional unit of living things, several studies have been conducted/performed about the cell. These research works have made us know some important information about cells like the presence of functioning parts/components called **organelles.**

Each of these components of the cell called organelles have special activities/roles that they play in the overall performance of the cell. *Some cells have organelles; i.e. Membrane bound components, some do not.* ***The most important organelle of any living cell is the nucleus.***

Cells are classified depending on the presence or the absence of membrane bound organelles.

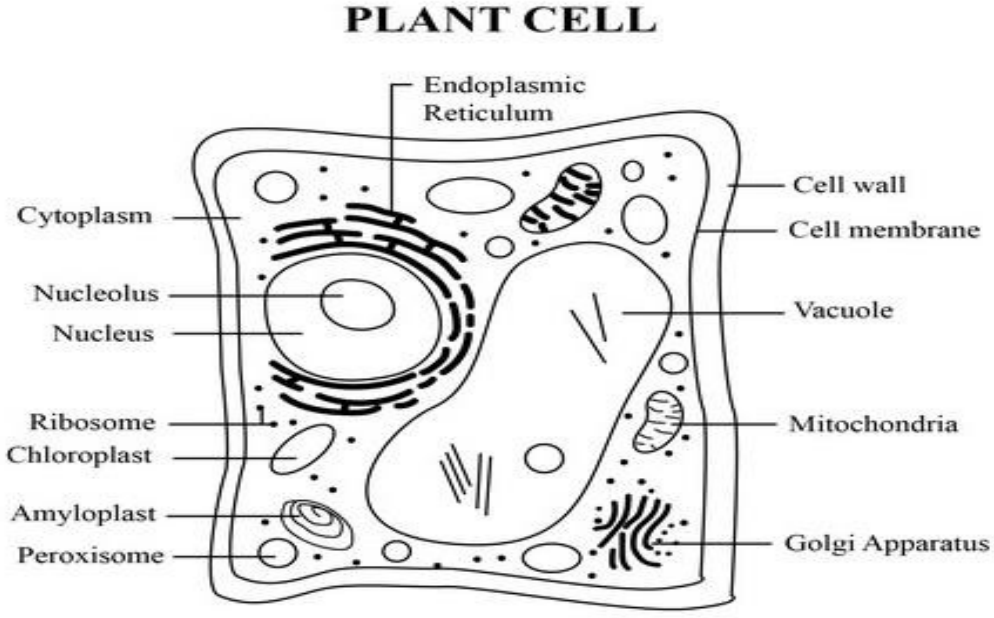
- Prokaryotic
- Eukaryotic
- Akaryotic

### Eukaryotic cell

**1. Eukaryotic cells** are those cells that have membranes around all their organelles, including the nucleus**. Examples include; protists, fungi, plants and animals.**

**A. Plant Cells**

The cell wall is made up of cellulose, which provides support to the plant. It has a large vacuole which maintains the turgor pressure. The plant cell contains chloroplast, which aids in the process of photosynthesis.

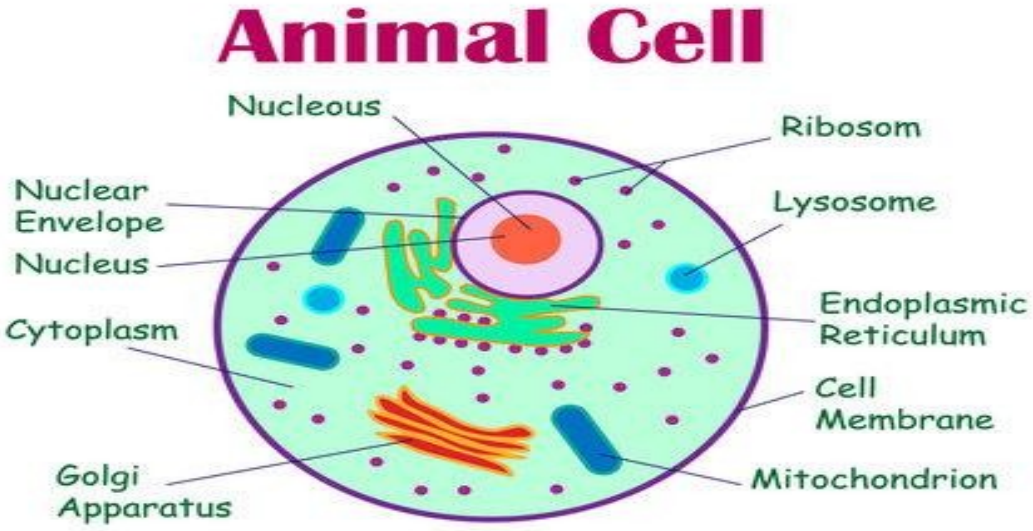



| Organelle | Function |
|---|---|
| Mitochondria | Site for respiration |
| Chloroplast | Contains green pigment or chlorophyll which absorbs sunlight for photosynthesis. |

| | |
|---|---|
| Nucleus | Controls all the vital activities of the cell.<br>Contains the genetic materials of the cell. |
| Vacuole | Acts as the store house of water containing various salts.<br>Contains organic substances. |
| Cell wall | Support or protect or gives shape to the cell. |
| Cell membrane | Controls the movement of materials in and out of the cell. |
| Cytoplasm | Sites for chemical reactions in the cell. |

**B. Fungal Cells** The cell wall is made of chitin. Some fungi have holes known as septa which allow the organelles and cytoplasm to pass through them. Fungal cells are adept at absorbing nutrients from their environment. They secrete enzymes that break down complex organic molecules into simpler compounds, which can then be absorbed by the fungal cells for sustenance.

**C. Animal Cells** These do not have cell walls. Instead, they have a cell membrane. That is why animals have varied shapes. They have the ability to perform phagocytosis and pinocytosis.




**D. Protozoa**. Protozoans are unicellular organisms. Some protozoa have cilia for locomotion. A thin layer called pellicle provides supports to the cell. Most protozoa are harmless and play important roles in nature, such as helping to break down dead plants and animals. But some types can make people or animals sick, so it's important to learn about them.

**Characteristics of Eukaryotic Cells**

The features of eukaryotic cells are as follows:

- Eukaryotic cells have the nucleus enclosed within the nuclear membrane.
- The cell has mitochondria.
- Flagella and cilia are the locomotory organs in a eukaryotic cell.
- A cell wall is the outermost layer of the eukaryotic cells.
- The cells divide by a process called mitosis.
- The eukaryotic cells contain a cytoskeletal structure.
- The nucleus contains a single, linear DNA, which carries all the genetic information.

- Structure Of Eukaryotic Cell
- The eukaryotic cell structure comprises the following:
- Plasma Membrane
- The plasma membrane separates the cell from the outside environment.

It comprises specific embedded proteins, which help in the exchange of substances in and out of the cell.

**Cell Wall**

A cell wall is a rigid structure present outside the plant cell. It is, however, absent in animal cells.

- It provides shape to the cell and helps in cell-to-cell interaction.
- It is a protective layer that protects the cell from any injury or pathogen attacks.
- It is composed of cellulose, hemicellulose, pectins, proteins, etc.

**Cytoskeleton**

The cytoskeleton is present inside the **cytoplasm,** which consists of microfilaments, microtubules, and fibres to provide perfect shape to the cell, anchor the organelles, and stimulate the cell movement.

**Endoplasmic Reticulum**

It is a network of small, tubular structures that divides the cell surface into two parts: luminal and extraluminal.

**Endoplasmic Reticulum is of two types:**

- Rough Endoplasmic Reticulum contains ribosomes.
- Smooth Endoplasmic Reticulum that lacks ribosomes and is therefore smooth.

**Nucleus**

The nucleoplasm enclosed within the nucleus contains DNA and proteins.
The nuclear envelop consists of two layers- the outer membrane and the inner membrane. Both the membranes are permeable to ions, molecules, and RNA material.
Ribosome production also takes place inside the nucleus.

**Golgi Apparatus**

It is made up of flat disc-shaped structures called **cisternae**.
It is absent in red blood cells of humans and sieve cells of plants.
They are arranged parallel and concentrically near the nucleus.
It is an important site for the formation of glycoproteins and glycolipids.

**Ribosomes**

These are the main site for protein synthesis and are composed of proteins and ribonucleic acids.

**Mitochondria**

These are also known as —**powerhouse of cells**ll because they produce energy.
It consists of an outer membrane and an inner membrane. The inner membrane is divided into folds called cristae.
They help in the regulation of cell metabolism.

**Lysosomes**

They are known as —**suicidal bags"** because they possess hydrolytic enzymes to digest protein, lipids, carbohydrates, and nucleic acids.
Plastids

These are double-membraned structures and are found only in plant cells. These are of three types:

- Chloroplast that contains chlorophyll and is involved in photosynthesis.
- Chromoplast that contains a pigment called carotene that provides the plants yellow, red, or orange colours.
- Leucoplasts that are colourless and store oil, fats, carbohydrates, or proteins.

**Differences between plant & animal cells**

| Plant cell | Animal cell |
|---|---|
| Contains chloroplast or manufactures food. | Chloroplast is absent or does not manufacture food. |
| Cell has definite shape | Cell has no definite shape or irregular shape. |
| Has cell wall | Cell wall absent |
| Contains large, permanent vacuoles | Contains small, temporary vacuoles. |
| Carbohydrate id stored as starch | Carbohydrate is stored a glycogen. |
| Stores lipids as oils | Stores lipids as fat |
| Has cellulose | Absence of cellulose. |

**Similarities between plant and animal cells**

- Presence of cytoplasm
- Possession of nucleus.
- Presence of cell membrane.
- Possession of mitochondrion.
- Presence of vacuoles.

**Differences between Cell Membrane & Cell Wall**

| Cell Membrane | Cell Wall |
|---|---|
| Present in all types of cells, in humans, animals, plants, bacteria, etc. | Present only in plants and in some fungi, bacteria, algae. |
| Semi-permeable | Completely or fully permeable |
| Flexible | Thick and rigid |
| Made up of proteins and lipids | Made up of cellulose |

**2. Prokaryotic cells**

**Prokaryotic cells** are single-celled microorganisms known to be the earliest on earth. Prokaryotes include **Bacteria and Archaea.** The photosynthetic prokaryotes include cyanobacteria that perform photosynthesis.

*A prokaryotic cell consists of a single membrane and therefore, all the reactions occur within the cytoplasm*. They can be free-living or parasites.

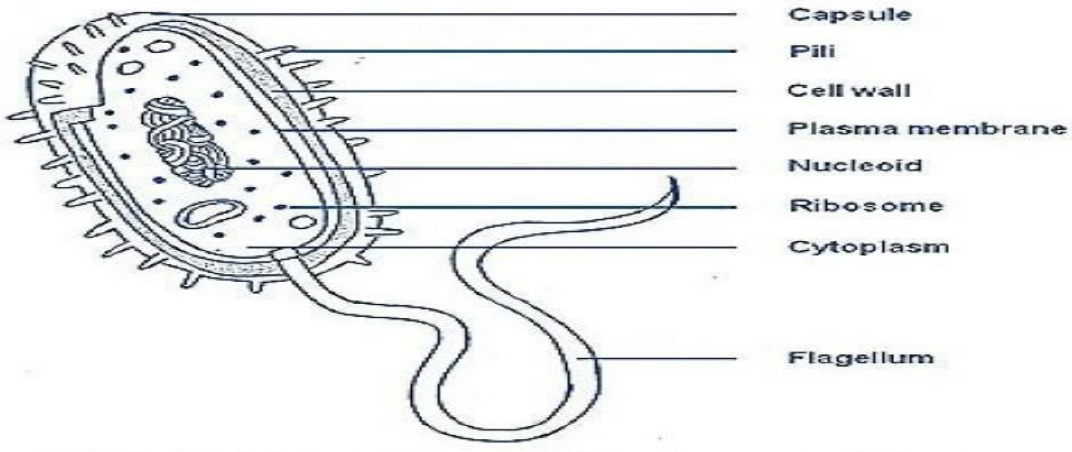
**Characteristics of Prokaryotic Cell**

Prokaryotic cells have different characteristic features. The characteristics of the prokaryotic cells are mentioned below.

- They lack a nuclear membrane.
- Mitochondria, Golgi bodies, chloroplast, and lysosomes are absent.
- The genetic material is present on a single chromosome.
- The histone proteins, the important constituents of eukaryotic chromosomes, are lacking in them.
- The cell wall is made up of carbohydrates and amino acids.
- The plasma membrane acts as the mitochondrial membrane carrying respiratory enzymes.
- They divide asexually by binary fission. The sexual mode of reproduction involves conjugation.

**Prokaryotic Cell Structure**

A prokaryotic cell does not have a nuclear membrane. However, the genetic material is present in a region in the cytoplasm known as the nucleoid. They may be spherical, rod-shaped, or spiral. A prokaryotic cell structure is as follows:




PROKARYOTIC CELL

**Capsule**– It is an outer protective covering found in the bacterial cells, in addition to the cell wall. It helps in moisture retention, protects the cell when engulfed, and helps in the attachment of cells to nutrients and surfaces.
**Cell Wall**– It is the outermost layer of the cell which gives shape to the cell.
Cytoplasm– The cytoplasm is mainly composed of enzymes, salts, cell organelles and is a gel-like component.
**Cell Membrane**– This layer surrounds the cytoplasm and regulates the entry and exit of substances in the cells.
**Pili**– These are hair-like outgrowths that attach to the surface of other bacterial cells.
**Flagella**– These are long structures in the form of a whip, that help in the locomotion of a cell.
**Ribosomes**– These are involved in protein synthesis.
**Plasmids**– Plasmids are non-chromosomal DNA structures. These are not involved in reproduction.
**Nucleoid Region**– It is the region in the cytoplasm where the genetic material is present.
A prokaryotic cell lacks certain organelles like mitochondria, endoplasmic reticulum, and Golgi bodies.

**Reproduction in Prokaryotes**

A prokaryote reproduces in two ways:

- Asexually by binary fission
- Sexually by conjugation

**3. Akaryocytes**, also known as **akaryotes or acaryotes**, are cells without a **nucleus**. The most common type of akaryocytes are viruses. The name is derived from the Greek prefix "a-", meaning "without" and the Greek "karyo-", meaning "nut" or "kernel". Akaryocytes also include viruses since

they lack a nucleus and cytoplasm but have instead, a central core of RNA or DNA. Akaryocytes are not part of the seven main ranks of taxa. Red blood cells are also classified as akaryocytes because they lack a cell nucleus after they have developed.

**Differences between prokaryotes and eukaryotes cells**

| **Prokaryotic Cells** | **Eukaryotic Cells** |
|---|---|
| 1.Prokaryotes are strictly single-celled.organisms | 1.Eukaryotes include both single- celled and multicellular species. |
| 2.DNA is circular in prokaryotes. | 2.DNA is linear in eukaryotes. |
| 3.Prokaryotes lack a nucleus. | 3.The nucleus is present in eukaryotes. |
| 4.Membrane-bound organelles are absent. | 4. Membrane-bound organelles are present. |

**Prokaryotic cell**

- Prokaryotes are creatures without a nucleus or other organelles in their cells.
- Bacteria and archaea, two separate groupings of prokaryotes with allegedly independent evolutionary histories, are separated.
- The majority of prokaryotes are tiny, single-celled creatures with a straightforward structure.

**Eukaryotic cell**

- Eukaryotes are organisms whose cells have membrane-bound organelles in addition to a nucleus.
- Eukaryotic creatures come in a great variety, including most algae, all animals, plants, fungus, and protists.
- Eukaryotes can have a single cell or many cells.

**Prokaryotes and eukaryotes can have both positive and negative impacts on human health.**

**Some of the negative impacts include**

- Causing diseases, such as bacterial infections
- Contributing to the spread of illnesses.

**To protect ourselves against prokaryotes**

- We can practice good hygiene, such as washing our hands regularlyproperly cooking our food.
- Taking antibiotics as prescribed by a doctor can help treat bacterial infections caused by prokaryotes

## STRAND 2 CYCLES
## SUB-STRAND 1 EARTH SCIENCE
## B8.2.1.1.1 Explain the process of carbon cycle.

The planet Earth and its atmosphere forms a ***closed system.***
**A closed system** is a physical system that does not allow either the entry or exit of matter [materials] into or out of it. From the definition of a closed system, the amount of carbon and carbon compounds do not change because none can either leave or enter the Earth.

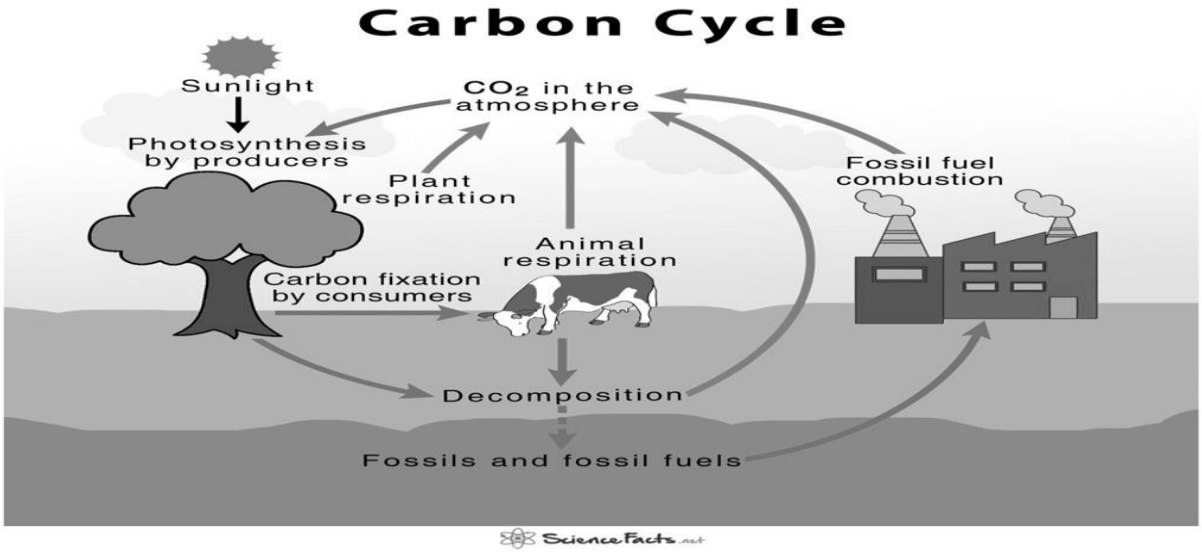
All living things and even some non-living things are made up of [contains] carbon. Carbon also forms part of the ocean, the air and even some rocks. In the atmosphere, carbon is mostly not found alone as a separate element but it is rather found to exist together with a gas like oxygen to form a compound like; carbon dioxide [CO2 ] and carbon monoxide [CO].

**Carbon circle** *is the continuous circulation of carbon in various forms through nature.*
Following are the major steps involved in the process of the carbon cycle:
- Carbon present in the atmosphere is absorbed by plants for photosynthesis.
- These plants are then consumed by animals and carbon gets bioaccumulated into their bodies.
- These animals and plants eventually die, and upon decomposing, carbon is released back into the atmosphere.
- Some of the carbon that is not released back into the atmosphere eventually become fossil fuels.
- These fossil fuels are then used for man-made activities, which pump more carbon back into the atmosphere.

**Carbon Cycle on Land**
1.Carbon in the atmosphere is present in the form of carbon dioxide. Carbon enters the atmosphere through natural processes such as respiration and industrial applications such as burning fossil fuels. The process of photosynthesis involves the absorption of $CO_2$ by plants to produce carbohydrates. The equation is as follows: $CO_2 + H_2O$ + energy $\rightarrow (CH_2O)n + O_2$
2.Carbon compounds are passed along the food chain from the producers to consumers. The majority of the carbon exists in the body in the form of carbon dioxide through respiration. The role of decomposers is to eat the dead organism and return the carbon from their body back into the atmosphere. The equation for this process is: $(CH_2O) + O_2 \rightarrow CO_2 + H_2O$

**Oceanic Carbon Cycle**
1.This is essentially a carbon cycle but in the sea. Ecologically, oceans take in more carbon than it gives out. Hence, it is called a —carbon sink.‖ Marine animals convert carbon to calcium carbonate and this forms the raw building materials require to create hard shells, similar to the ones found in clams and oysters.
2.When organisms with calcium carbonate shells die, their body decomposes, leaving behind their hard shells. These accumulate on the seafloor and are eventually broken down by the waves and compacted under enormous pressure, forming limestone.
When these limestone rocks are exposed to air, they get weathered and the carbon is released back into the atmosphere as carbon dioxide.

**Main stages in the Carbon cycle**
The entire Carbon cycle can be summarized into four [4]stages. These are;
a. Photosynthesis,
b. Respiration,
c. Burning or combustion
d. Decay or decomposition.




**A.** Carbon moves from the atmosphere to plants. In the atmosphere, carbon is attached to oxygen in a gas called carbon dioxide ($CO_2$). Through the process of photosynthesis, carbon dioxide is pulled from the air to produce food made from carbon for plant growth. *Photosynthesis is the main process by which Carbon in the form of Carbon dioxide is removed from the atmosphere*.
***Photosynthesis*** *is the process during which plants combine water [H2O] and 2 carbon dioxide [$CO_2$ ] to form/produce glucose [C H O ] oxygen [O ] 6 12 6 and 2 using light energy from the sun.* The energy needed for the above process is trapped into the plant by the green pigment chlorophyll **$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$**

**B.** Carbon moves from plants to animals. Through food chains, the carbon that is in plants moves to the animals that eat them. Animals that eat other animals get the carbon from their food too.
***Respiration*** *is the process during which all living things break down food substances [materials] to release energy with or without the use of oxygen*. This activities that release carbon or carbon compounds in to the atmosphere **C6H12O6 + 6O2 → 6CO2 + 6H2O**

**C.** Carbon moves from plants and animals to soils. When plants and animals die, their bodies, wood and leaves decays bringing the carbon into the ground. Some is buried and will become fossil fuels in millions and millions of years. Plants and Animals when eventually die, the dead plants and animals are eaten by the Decomposers such as Bacteria and other Microorganisms. The carbon present in these organisms is released into the atmosphere in the form of carbon dioxide.
***Decay or decomposition*** *is the process during which organic matter [dead plants and animal materials] are broken down into inorganic forms like carbon dioxide, methane and mineral salt.* This activities that release carbon or carbon compounds in to the atmosphere

**D**. Carbon moves from fossil fuels to the atmosphere when fuels are burned. When humans burn fossil fuels to power factories, power plants, cars and trucks, most of the carbon quickly enters the atmosphere as carbon dioxide gas. Each year, five and a half billion tons of carbon is released by burning fossil fuels. Of this massive amount, 3.3 billion tons stays in the atmosphere. Most of the remainder becomes dissolved in seawater.
***Combustion*** *is a chemical reaction that involves the oxidation of fuel; i.e. Action of oxygen on fuel to release energy.* This activities that release carbon or carbon compounds in to the atmosphere

***<u>The four [4] main processes above can be further divided into two [2] main groups.</u>***
*These are;*

1. Activities that remove/take carbon or carbon compounds from the atmosphere;
***Photosynthesis is the main process by which Carbon in the form of Carbon dioxide is removed from the atmosphere***

2. Activities that release carbon or carbon compounds in to the atmosphere***. Respiration, Decomposition or Decay and Combustion or Burning.***

**The table below is a summary of the various forms/compounds of carbon and the processes which change them into other forms.**

| **Process in the carbon cycle** | **The form in which carbon starts** | **The form in which carbon ends** |
|---|---|---|
| Photosynthesis | Carbon dioxide [ $O_2$ ] | Glucose [$C_6$ $H_{12}$ $O_6$ ] |
| Respiration | Glucose [$C_6$ $H_{12}$ $O_6$ ] | Carbon dioxide [ $O_2$ ] |
| Combustion [burning] | Fuel like methane/wood [C $H_4$ ] | Carbon monoxide [CO] and Carbon dioxide [ $CO_2$ ] |

**B8.2.1.1.2 Describe the role of carbon cycle to the environment**

**<u>The carbon cycle has several effects on the food chain. Some of these effects include:</u>**
1. Carbon dioxide (CO2) is used by plants during photosynthesis to produce glucose, which is a source of energy for all living organisms in the food chain.
2. When plants are consumed by herbivores, the carbon stored in the plants is transferred to the herbivores.
3. When herbivores are consumed by carnivores, the carbon is further transferred up the food chain.
4. Decomposers break down dead organisms and release carbon back into the environment, allowing it to be reused by plants in the cycle.

**<u>There are several activities that can promote the carbon cycle</u>**.
Here are a few examples:
**1. Planting trees:** Trees absorb carbon dioxide from the atmosphere during photosynthesis, helping to reduce the amount of carbon dioxide in the air.
**2. Conserving forests:** Protecting and preserving forests helps to maintain their ability to absorb carbon dioxide and release oxygen through photosynthesis.
**3. Using renewable energy sources:** Transitioning to renewable energy sources such as solar or wind power can reduce the reliance on fossil fuels, which release carbon dioxide when burned.
**4. Practicing sustainable agriculture: Implementing** sustainable farming practices, such as crop rotation and organic farming, can help to sequester carbon in the soil and reduce greenhouse gas emissions.
**5. Recycling and waste management:** Properly managing waste, including recycling and composting, can help to reduce the amount of methane, a potent greenhouse gas, released from landfills.

**Activities that can disrupt the carbon cycle.**

Here are a few examples:

**1. Deforestation**: Clearing forests for agriculture, logging, or urban development reduces the number of trees available to absorb carbon dioxide, leading to increased levels of carbon dioxide in the atmosphere.

**2. Burning fossil fuels:** The combustion of fossil fuels, such as coal, oil, and natural gas, releases large amounts of carbon dioxide into the atmosphere, contributing to the greenhouse effect and climate change.

**3. Land degradation**: Activities like overgrazing, improper land management, and soil erosion can reduce the ability of vegetation and soil to absorb and store carbon, disrupting the carbon cycle.

**4. Industrial processes**: Certain industrial processes, such as cement production and chemical manufacturing, release carbon dioxide and other greenhouse gases into the atmosphere.

**5. Converting natural ecosystems, such as forests or grasslands, into agricultural or urban areas** can disrupt the carbon cycle by reducing the amount of vegetation available to absorb carbon dioxide.

**Effects of carbon cycle disruption:**

1. Increased greenhouse gas levels: Disruption of the carbon cycle leads to an increase in greenhouse gases, such as carbon dioxide, in the atmosphere. This contributes to global warming and climate change.
2. Ocean acidification: Higher carbon dioxide levels in the ocean can lead to ocean acidification. This can harm marine life, particularly organisms that rely on calcium carbonate for their shells or skeletons, such as coral reefs.
3. Changes in ecosystems: Disruption of the carbon cycle can result in changes to ecosystems. This can include shifts in species distribution, loss of biodiversity, and alterations in the availability of resources for different organisms.
4. Impacts on plant growth: Carbon dioxide is essential for photosynthesis, and any disruption in its levels can affect plant growth and productivity. This can have cascading effects on food webs and agricultural systems.

**The relationship between the greenhouse gases and carbon cycle.**

1.Greenhouse gases and the carbon cycle are closely interconnected. The carbon cycle is a natural process that involves the exchange of carbon dioxide ($CO_2$) between the atmosphere, land, and oceans. Greenhouse gases, including $CO_2$, trap heat in the Earth's atmosphere and contribute to the greenhouse effect.

2.During the carbon cycle, plants absorb $CO_2$ from the atmosphere through photosynthesis, converting it into organic matter. When plants and animals respire or decompose, they release $CO_2$ back into the atmosphere. This is known as the biological carbon cycle.

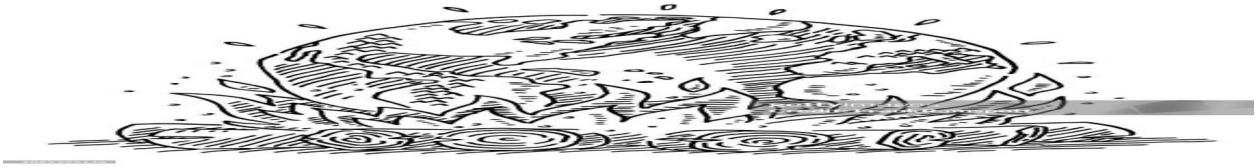
Additionally, the carbon cycle involves the exchange of $CO_2$ between the atmosphere and the oceans. The oceans act as a carbon sink, absorbing $CO_2$ from the atmosphere. This process helps regulate the levels of $CO_2$ in the atmosphere.

3.Human activities, such as burning fossil fuels and deforestation, have disrupted the carbon cycle by releasing large amounts of $CO_2$ into the atmosphere. This excess $CO_2$ enhances the greenhouse effect, leading to global warming and climate change.

In summary*, the carbon cycle and greenhouse gases are interconnected through the exchange of $CO_2$ between the atmosphere, land, and oceans. Disruptions to the carbon cycle, such as increased $CO_2$ emissions, contribute to the accumulation of greenhouse gases in the atmosphere, resulting in the greenhouse effect and its associated impacts on the Earth's climate*

**Global warming**

*This is an increase in average global temperatures.* It is caused by an increase in Greenhouse Gases in the Atmosphere



**Human activities that contribute to global warming or Causes of global warming.**

- Burning of fossil fuels/ petrol/ hydrocarbons/ wood/ coal etc.
- Deforestation/ cutting down trees or vegetation.
- Industrial activities or fumes from industries
- Bush or forest fires.
- Emission of exhaust fumes from cars.
- Cooking of food.
- Agricultural activities or breeding of cattle which produce methane.

**Effects of global warming**

- An increase in atmospheric temperature.
- The melting of icebergs.
- Less availability of freshwater bodies such as rivers, streams, lakes.
- Increase use of chemical fertilizers on crop lands.
- Wide spread extinction of species.
- Change in the ecosystem or climate.
- Massive crop failure.
- Increase in drought or fires.
- Rise in the sea level.

**Ways of minimizing global warming or possible factors to address the problem of global warming**

- Planting more trees.
- Encouraging the use of natural gas and liquefied petroleum gas.
- Recycling of plastic bags and containers.
- Changing light bulbs with compact fluorescent light.
- Purchases of energy efficiency products.
- Replacement of old appliances.

**TEST YOUR MIND**

a. Any process by which plants convert sunlight into sugar compounds is called _____.
b. _____ _____ is the process of extracting energy through breaking down of glucose from food.
c. The continuous circulation of carbon in various forms through nature is known as _____ _____.
d. _____ _____, the world's primary energy source, are derived from prehistoric remains of living organisms.
e. _____ that live for a long period could trap carbon.
f. The _____ process is described as the breaking down of dead organic substances that eventually become part of the soil.
g. New organisms use carbon to form key molecules, such as _____.
h. The _____ that plants use to make sugar compounds are CO2, sunlight, and water.
i. Organisms exhale _____ _____, a gas that is a by-product of cellular respiration.

## STRAND 2 CYCLES

## SUB-STRAND 2 LIFE CYCLE OF ORGANISMS

**B8.2.2.1.1 Describe the life cycle and economic importance of Anopheles mosquito.**

**Mosquitoes** are slender, long-legged insects that are easily recognised by their long **proboscis** (pointy piercing mouthparts) and the presence of scales on most parts of their body. Mosquitoes belong to the class of insects, hence are characterised by the presence of 3 pairs of legs, and to the order ***Diptera*** which is characterised by a single pair of wings (along with other flies). Adult anophelines have slender bodies with 3 sections: head, thorax and abdomen.

- **The head** - is specialized for acquiring sensory information and for feeding. The head contains the eyes and a pair of long, many-segmented antennae. The antennae are important for detecting host odors as well as odors of breeding sites where females lay eggs. The head also has an elongate, forward-projecting proboscis used for feeding, and two sensory palps (organ near the mouthpart).
- **The thorax** is specialized for locomotion. Three pairs of legs and a pair of wings are attached to the thorax.
- **The abdomen** is specialized for food digestion and egg development. This segmented body part expands considerably when a female takes a blood meal. The blood is digested over time serving as a source of protein for the production of eggs, which gradually fill the abdomen.

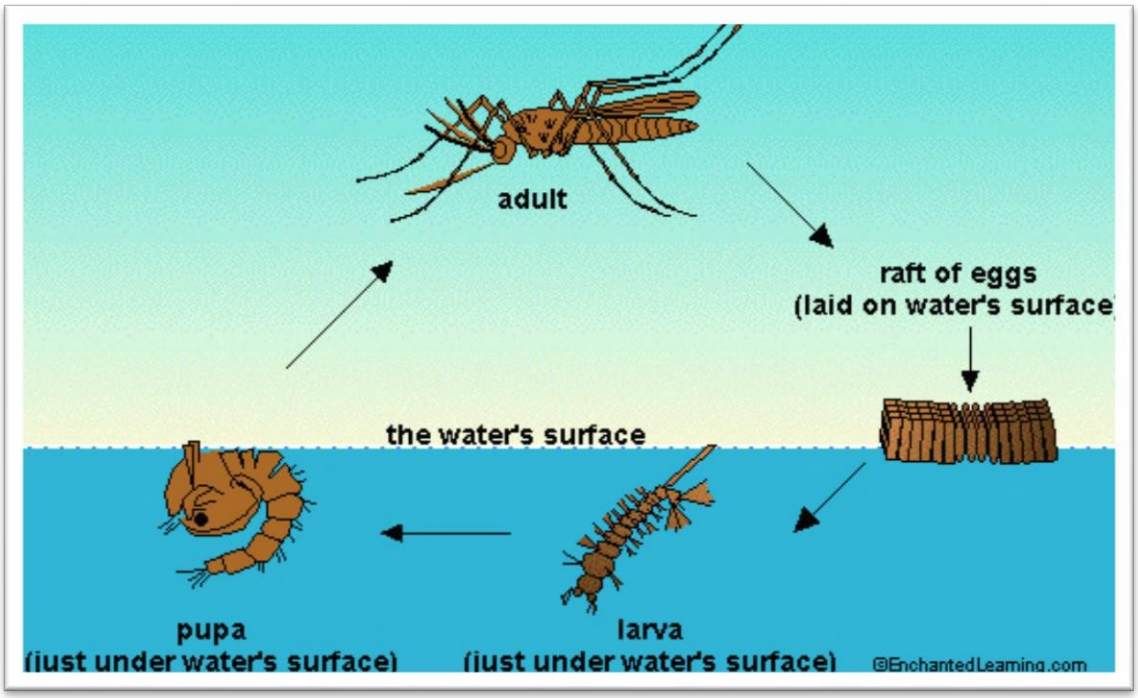
**What is the difference between male and female mosquitoes?**

Male mosquitoes have more flagella or fine hairs on their antennae, so many so that it appears noticeably bushy to the naked eye. These flagella are important to a male mosquito‘s hearing, which comes in handy when the male is looking for female mosquitoes.

A female mosquito‘s antennae are less bushy and contain several odor receptors that help her target blood sources so that she can feed and reproduce. Only female mosquitoes bite and transmit malaria. Anopheles mosquitoes can be distinguished from other mosquitoes by the palps (sensory organ near the mouthpart), which are as long as the proboscis, and by the presence of discrete blocks of black and white scales on the wings. Adult Anopheles can also be identified by their typical resting position: males and females rest with their abdomens sticking up in the air rather than parallel to the surface on which they are resting

**Anopheles life-stages:**

Life Stages: Like all mosquitoes, anophelines go through two phases. The first is aquatic and lasts 5-14 days depending on the species and the ambient temperature, and comprises the egg, larval and pupa stages. The second is aerial and involves the adult. The adult females can live up to a month (or more in a laboratory setting) but the majority live 2 weeks or less in nature. The adult stage is when the female Anopheles mosquito acts as a malaria vector.




**Eggs:** One or two days after blood-feeding, adult females lay 50 to 300 eggs per oviposition and can lay between 800 and 1000 eggs during their life. Eggs are laid singly directly on water and are unique in having floats on either side. Eggs are not resistant to drying and hatch within 2-3 days.

**Larva:** A larva emerges from each egg and floats parallel to the surface of the water to breathe. Anopheles life-stages: It feeds on particles present in the water. Measuring just 1mm, the larva undergoes three moults to reach 5mm in the fourth stage. Larvae occur in a wide range of habitats but most species prefer clean, unpolluted water. Larvae of Anopheles mosquitoes have been found in fresh or salt-water marshes, mangrove swamps, rice fields, grassy ponds, tree trenches, canals, ditches, the edges of streams and rivers, and small temporary rain pools. After the 4th stage, the larva turns into an intermediate stage between larva and adult, the pupa.

**Pupa:** The pupa is comma-shaped when viewed from the side. As with the larvae, pupae must come to the surface frequently to breathe, which they do through respiratory trumpets present on their cephalothorax.
After a few days the adult mosquito emerges from the pupa. The complete cycle from egg to adult typically takes between 9 and 20 days

**Adult mosquito behaviour**

Adult mosquitoes usually mate within a few days after emerging from the pupal stage. The males form swarms around dusk often nearby huts within villages, and the females fly into the swarms to mate. A gambiae females usually only mate once in their lifespan. Males and females feed on nectar and other plant exudates. Only females feed on blood - males do no have the right mouthparts to do this. In the best tropical conditions, the average lifespan of Anopheles is about 2 weeks, depending on the climatic factors of nature. Adult Anopheles mosquitoes are thought to typically disperse a few hundred meters within villages, though exceptionally mosquitoes can fly longer distances (~3-4 km).

**Egg production cycle**

Females feed on sugar sources for energy but require a blood meal for the development of eggs. They mostly bite between sunset and sunrise (6 pm to 6 am). After obtaining a full blood meal, the female will rest 2 to 3 days while the blood is digested and eggs are developed. Once the eggs are

fully developed, the female lays them. The cycle repeats itself until the female dies. Females can survive up to a month (or longer in a laboratory). Their chances of survival depend on temperature and humidity, but also on their ability to successfully obtain a blood meal while avoiding host defenses. Preferred sources for blood meals: One important behavioral factor for malaria transmission is the degree to which an Anopheles species prefers to feed on human or animals, such as cattle. Anopheles species that prefer human blood are more likely to transmit the malaria parasites from one person to another. Most Anopheles mosquitoes do not exclusively have a preference between human or animals as a food source. However, the primary malaria vectors in Africa strongly prefer human blood and, consequently, are the most efficient malaria vectors. Anopheles gambiae feeds at night either indoors (endophagic) or outdoors (exophagic). After blood feeding, it prefers to rest indoors but some can rest outdoors in suitable resting places, such as holes, animal sheds, and dense vegetation

**How the female anopheles  mosquito as the vector of the parasite that causes malaria**.
The female Anopheles mosquito is the vector of the parasite that causes malaria. When an infected female mosquito bites a human, it injects the malaria parasite, known as Plasmodium, into the bloodstream. The parasite then travels to the liver, where it multiplies and matures. After leaving the liver, the parasites invade red blood cells, causing them to burst and release more parasites into the bloodstream. This cycle of infection and multiplication leads to the characteristic symptoms of malaria. The female Anopheles mosquito plays a crucial role in transmitting the parasite from one person to another through its bites

**B8.2.2.1. 2 Discuss the impact of Anopheles mosquito on humans and how it can be controlled**

**The female Anopheles mosquito plays a significant role as a vector of Plasmodium, the parasite that causes malaria in humans**.

Here are some impacts of the female Anopheles mosquito as a vector of Plasmodium on humans:

**1. Transmission of malaria**: When a female Anopheles mosquito bites a person infected with Plasmodium, it ingests the parasite along with the person's blood. The mosquito then becomes a carrier of the parasite. When the infected mosquito bites another person, it injects the Plasmodium parasites into their bloodstream, leading to malaria transmission.
**2. Spread of the disease:** Female Anopheles mosquitoes are capable of transmitting malaria to multiple individuals during their lifespan, which can range from a few weeks to several months. This ability to transmit the disease to multiple hosts increases the potential for malaria to spread **within a population.**
**3. Geographic distribution:** The presence of female Anopheles mosquitoes determines the geographic distribution of malaria. These mosquitoes are found in various regions around the world, particularly in tropical and subtropical areas where the climate is suitable for their survival. As a result, malaria is prevalent in these regions.
**4. Impact on human health:** Malaria is a significant public health concern, causing millions of cases and hundreds of thousands of deaths each year. The disease can lead to severe illness, especially in young children and pregnant women. It can also have long-term effects on individuals, such as anemia and organ damage.
**5. Economic burden:** Malaria has a substantial economic impact on affected countries. The disease can result in decreased productivity due to illness and absenteeism from work or school. Additionally, the cost of treating and preventing malaria, as well as the burden on healthcare systems, can be significant.

**The table below is a list of some diseases in animals and the species/breed of mosquitoes that causes it.**

| Disease | Mosquito breed that causes it |
|---|---|
| Dengue fever | Aedes mosquito |
| Malaria fever | Anopheles mosquito |
| Chikungunya | Aedes mosquito |
| West Nile fever | Culex mosquito |
| Heartworm | Anopheles mosquito |
| Zika fever | Aedes mosquito |

**Methods of controlling mosquitoes:**

1. Eliminate standing water: Mosquitoes breed in stagnant water, so removing any sources of standing water around your home, such as buckets, flower pots, or birdbaths, can help reduce their population.
2. Use mosquito repellents: Applying mosquito repellents containing DEET, picaridin, or oil of lemon eucalyptus on exposed skin can provide protection against mosquito bites.
3. The use of traps to catch mosquitoes.
4. Adding salt to standing water.
5. Use mosquito nets: When sleeping outdoors or in areas with high mosquito populations, using mosquito nets can provide an additional layer of protection.
6. Consider mosquito control products: In areas with persistent mosquito problems, using mosquito control products such as insecticide-treated bed nets, mosquito traps, or larvicides can be effective in reducing mosquito populations

**The different methods of controlling mosquitoes.**

A. **Physical methods** of mosquito control involve physically removing or preventing mosquitoes from breeding or entering an area. This can include measures like removing standing water where mosquitoes lay their eggs, using mosquito nets or screens to keep them out of buildings, or using traps to capture and kill adult mosquitoes.
B. **Chemical methods** of mosquito control involve using insecticides to kill mosquitoes. This can be done through spraying insecticides in areas where mosquitoes are present or treating bodies of water with larvicides to kill mosquito larvae.
C. **Biological methods** of mosquito control involve using natural predators or pathogens to control mosquito populations. For example, introducing mosquito-eating fish or using bacteria that infect and kill mosquito larvae can help reduce their numbers.
D. **Environmental methods** of mosquito control involve modifying the environment to make it less suitable for mosquitoes to breed or survive. This can include draining or filling in areas of standing water, improving sanitation to reduce mosquito breeding sites, or using landscaping techniques to discourage mosquito populations.
E. **Integrated Pest Management (IPM)** is a comprehensive approach that combines multiple methods of mosquito control. It involves assessing the specific mosquito problem, implementing a combination of physical, chemical, biological, and environmental control methods, and monitoring the effectiveness of these measures over time.

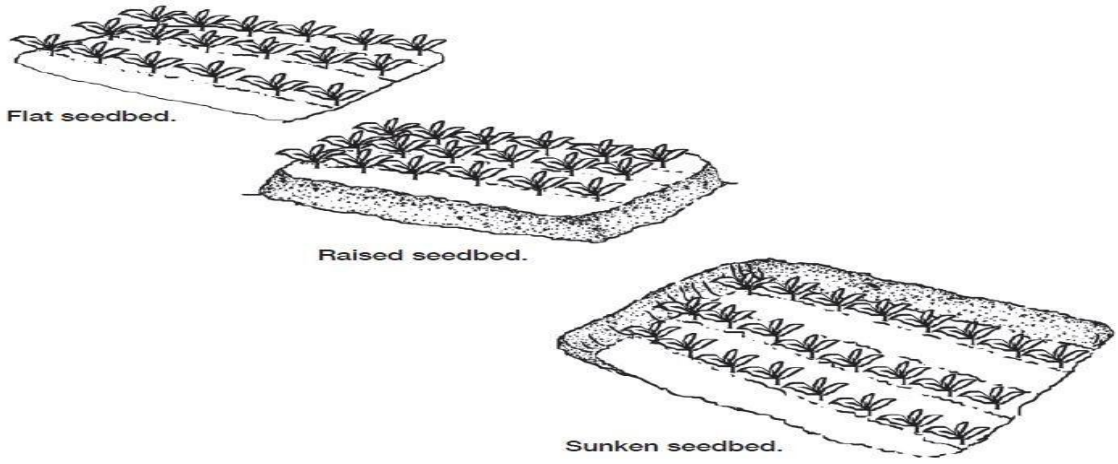
## STRAND 2 CYCLES
## SUB-STRAND 3 CROP PRODUCTION
### B8.2.3.1.1 Explore the different seed beds for planting crops in your community

**A seed bed [seedling bed]** is a local soil environment tilt within which seeds are nursed/planted.

**Seed bed preparation:** After clearing the land of vegetation and debris, the beds should be marked for digging. The size and shape of the bed depends on the gardener, but the width and shape must be such as to provide easy access without treading on the soil when planting out, weeding, stirring or watering.

**The entire process of preparing a seed bed is grouped into five [5] stages/steps.**
These are;
1. The removal of stumps, stones and debris that can physically prevent the seedling germination and growth.
2. The leveling up of the site/area which has demarcated for the bed for uniform [even] drainage; i.e. Entry and distribution of water
3. Making the soil loose by digging and breaking lumps. This practice promotes the entry of air; i.e. Improves aeration, and the entry of water; i.e. Improves drainage.
4. Improving; i.e. Enhancing the soil structure by adding organic matter [humus].
5. Adjusting the nitrate and the phosphate levels of the soil using the right fertilizer

**Types of beds**




1. **Raised beds** are used in high rainfall areas or during the very heavy rainfall season.

**Condition for using raised seedbeds**
- In high rainfall areas.
- Poor drainage or water logged areas.
- During rainy seasons.

2. **Sunken beds** are mainly used where rainfall is low or during the dry season to conserve much moisture.

**Condition for using sunken seedbeds**
Low rainfall areas.
During the dry season.
When there is the need to conserve moisture.

**Differences between Raised and sunken bed**

| Raised beds | Sunken beds |
|---|---|
| Beds are raised above the ground. | Beds are lower than ground level. |
| Has rapid drainage | Has slow drainage |

| | |
|---|---|
| Suitable for growing deep- rooted crops. | Suitable for growing shallow-rooted crops. |
| It is not flooded during heavy rain. | Can be flooded or water –logged during heavy rain. |

**3. Flat beds** are used where water availability is adequate with no drainage problems. Flat beds are usually enhanced during the farming season. For instance; in some areas, crops like; maize, sorghum, beans and potatoes can be started/cultivated on a flat bed. But as the season progresses, soil is thrown into the crop row to mound up; i.e. Heap around the plant. This is called hilling-up. Hilling-up is done to; control in-row weeds, provide support for the growing plants and to improve the soil drainage.

**Methods of sowing seeds**

- **Broadcasting:** This is the scattering seeds at random and uniformly over the soil surface.
- **Drilling:** This is creating shallow trenches or drilling and spreading seeds in them.
- **Planting at stake or seed hole:** planting at stake" as a method of directly planting seeds on farmland without any prior nursing

**Select different plants (seed, seedlings, cutting,) and plant them in different seed bed**.

**Plants can be propagated through various parts, including:**

**1. Seeds**: Many crops are propagated through seeds, which are the mature ovules of plants. Examples of crops propagated by seeds include grains like rice, wheat, and corn, as well as beans, peas, and many vegetables.

**2. Stem cuttings**: Certain plants can be propagated by taking cuttings from their stems and encouraging them to develop roots. This method is used for propagating crops like grapes, sugarcane, and various fruit trees.

**3. Tubers:** Some plants are propagated through tubers, which are swollen, underground stems. Examples of crops propagated through tubers include potatoes and sweet potatoes.

**4. Bulbs:** Certain plants produce bulbs as a form of storage organ, and these can be used for propagation. Crops like onions and garlic are propagated through bulbs.

**5. Rhizomes:** Plants with underground horizontal stems called rhizomes can be divided and replanted to propagate new growth. Crops such as ginger and turmeric are propagated through rhizomes.

**6. Suckers:** Some plants produce shoots called suckers that can be removed and replanted to propagate new plants. Crops like bananas are commonly propagated through suckers.

**7.Leaves:** Certain plants can be propagated through leaf cuttings, where a leaf is removed from the parent plant and encouraged to develop into a new plant. This method is commonly used for plants such as African violets and succulents like jade plants and certain types of begonias.

**8. Roots:** Some plants can be propagated through root division, where the roots of a mature plant are divided and replanted to produce new plants. This method is often used for perennial plants such as hostas and ornamental grasses.

**Nursery**

It is a place where seedlings are raised before they are transported on to the field.

**Reasons for nursing seeds**

- Enhancement of quick or easy germination.
- Easy maintenance of seedlings.
- Giving seedlings a good start.
- Hardening of seedling before transplanting.
- Reduction of wastage of seeds.
- Selection of healthy seedlings for transplanting
- Planting crops with small seeds which cannot be planted directly into the soil.

## STRAND 2 LIFE CYCLES OF ORGANISMS
## SUB-STRAND 4 ANIMAL PRODUCTION
### B8.2.4.1.1 Compare and contrast the different types of feed for different types of animals.

### Animal feed
**Animal feed** refers to the food that is given to animals, both domestic and commercial, to meet their nutritional needs. It is formulated to provide the necessary nutrients, vitamins, and minerals that animals require for growth, development, and overall health. Animal feed can come in various forms, such as pellets, grains, or liquid, and it is designed to be easily consumed and digested by the specific animal species it is intended for. The composition of animal feed can vary depending on the type of animal and their dietary requirements. Some common ingredients that farmers may use include grains (such as corn, wheat, or barley), protein sources (such as soybean meal or fish meal), vitamins, minerals, and sometimes additives like probiotics

**Feeding** in farm animals refers to the act of providing them with food or feed to meet their nutritional needs. It involves the process of selecting, preparing, and distributing the appropriate feed to the animals. Feeding in farm animals is a critical aspect of animal husbandry as it directly impacts their growth, health, and productivity. It involves understanding the specific dietary requirements of different animal species and providing them with a balanced and nutritious diet. **Feeding practices can vary depending on factors** such as the **type of animal, their age**, **weight, and production goals**. Regular monitoring of feed intake and adjusting the feeding regimen as needed is also important to ensure optimal nutrition.

### Basic Nutrients in Animal Feeds
The basic nutrients that animals require for maintenance, growth, reproduction, and good health Include
1. Carbohydrates, 2. Protein, 3. Fats and oils, 4. Minerals, 5. Vitamins, and 6. Water.

**Animal feed typically contains a variety of nutrients essential for the health and growth of animals. These nutrients and their sources in different types of animal feed include:**

**1. Proteins:**
- Sources: Soybean meal, fish meal, meat and bone meal, canola meal, cottonseed meal.
- Types of animal feed: Used in feeds for poultry, swine, cattle, and aquaculture.

**2. Carbohydrates:**
- Sources: Corn, barley, wheat, oats, sorghum.
- Types of animal feed: Commonly included in feeds for poultry, swine, and ruminants.

**3. Fats and Oils**:
- Sources: Soybean oil, corn oil, animal fats.
- Types of animal feed: Included in diets for poultry, swine, and aquaculture for energy provision.

**4. Vitamins:**
- Sources: Synthetic vitamins or added through fortified ingredients.
- Types of animal feed: Essential components in feeds for all types of livestock to support overall health.

**5. Minerals (e.g., calcium, phosphorus, potassium):**
- Sources: Limestone, dicalcium phosphate, salt.
- Types of animal feed: Essential components in feeds for all types of livestock to support bone development and overall health.

**6. Fiber:**
- Sources: Alfalfa meal, soybean hulls, beet pulp.
- Types of animal feed: Included in ruminant diets and some non-ruminant diets to support digestive health.

## Objective of feed processing

• To make the feed more palatable.
• To detoxify or remove undesirable ingredients.
• To make the storage easy and safe.
• To increase nutrient content and nutrient availability.
• To change the particle size or density of feed
• To make animal production more economical

## The three main classifications of animal feed are:

**1. Roughage:** This includes fibrous materials such as hay, grass, and silage, which provide bulk and help maintain proper digestion in animals. Roughages are feed ingredients that are high in fiber and low in energy. Here are some examples of roughages:
- Hay: Hay is a common roughage made from dried grasses or legumes.

- Straw: Straw is the dried stalks of cereal crops, such as wheat or barley, and is often used as a roughage.

- Pasture grass: Fresh grass that animals graze on in a pasture is considered a roughage.

- Silage: While silage can also be considered a concentrate, it can also be a roughage if it contains a high proportion of fibrous material.

- **Hay:** *Hay is a type of roughage that is made from dried grasses, legumes, or other plants*. It is commonly used as feed for livestock, such as horses, cows, and goats. Hay is harvested when the plants are at their peak nutritional value and then dried to reduce moisture content. It provides fiber, energy, and some protein to the animal's diet.

- **Grass:** Grass is another type of roughage that is commonly consumed by grazing animals. It refers to various species of plants that belong to the grass family, such as Bermuda grass, Timothy grass, or Ryegrass. Grass provides a good source of fiber, vitamins, and minerals for animals. It is typically consumed fresh while grazing in pastures.

- **Silage:** *Silage is a type of feed that is made by fermenting and preserving green forage crops, such as corn, grass, or alfalfa.* The forage is chopped into small pieces, packed tightly into a silo or other storage structure, and then sealed to create an anaerobic environment. This fermentation process helps preserve the nutrients in the forage and creates a highly digestible feed for animals. Silage is commonly used as a feed for dairy cows and other livestock.

**2. Concentrates**: These are feed ingredients that are high in energy and protein, such as grains, oilseeds, and protein supplements. Concentrates are typically used to supplement the diet and provide additional nutrients. Concentrates are feed ingredients that are high in energy and low in fiber. Here are some examples of concentrates:
- Corn: Corn is a common concentrate used in animal feed due to its high energy content.

- Soybean meal: Soybean meal is a protein-rich concentrate made from soybeans.

- Wheat bran: Wheat bran is a byproduct of wheat milling and is often used as a concentrate in animal feed.

- Barley: Barley is another grain that is often used as a concentrate in animal feed.

**3. Mixed feed:** refers to a type of animal feed that is created by combining different ingredients, such as grains, protein sources, vitamins, and minerals, to create a balanced diet for the animal. Mixed feed allows for more flexibility in adjusting the proportions of different ingredients based on the specific needs of the animal.

## Basic terms used in animal feed

- **Fodder** refers to food, typically plant material, that is given to livestock as feed. It can include hay, straw, silage, or other types of crops that are grown specifically for animal consumption.

- **Supplements:** These are feed additives that are used to provide specific nutrients that may be lacking in the animal's diet. They can include vitamins, minerals, and protein sources.

- **Forages:** These are plants that are grown specifically for animal grazing, such as pasture grasses and legumes.

- **By-products:** These are materials that are left over from the production of human food or other industries, such as bran, beet pulp, and distillers grains.

- **Pasture** is a piece of land covered with grass and leguminous crops When animals like livestock live on a pasture, that method of farming is called pastoral farming.

- **Creep feed** is the first type of solid feed that is given to young ruminants after they have been weaned.

## Animal ration

**Ration** is the amount of daily feed which is given to an animal. Or
It is the total amount of feed which is provided to an animal over a 24 hour period.

## Types of Ration

A. Balanced ration b. Maintenance ration
C. Production ration d. Supplementary ration

**A.Balanced ration** is the feed that contains all the essential nutrients in their correct amount and adequate proportion for feeding animals to meet their production requirement/purpose. The balanced ration includes a mix of nutrients like protein, vitamins, and minerals in the right proportions. An example is a diet for dairy cows that includes hay, grains, and a protein supplement.

**B. Maintenance ration** is the feed that is given to farm animals to help them to keep/retain their basic metabolic functions. The maintenance ration maintains an animal's weight without any significant gain or loss. An example is a diet for adult horses that includes grass hay and a salt/mineral block.

**C. Production ration** is the feed which is given to farm animals for a specific produce or purpose. The production ration supports growth and milk production in animals like dairy cows. An example is a diet for lactating sows that includes grains, soybean meal, and vitamins.

**D. Supplementary ration** are those feeds that are given to farm animals to support [supplement] the main [production] ration. Supplementary ration in animal production involves providing additional feed, such as grain, hay, or silage, to meet the nutritional needs of livestock when pastures are deficient in energy and protein.

## The importance of animal feed includes

**A.** Promoting health and wellbeing,
**b.** Supporting growth and reproduction,
**C.** Providing immunity against infections,
**d.** Optimizing animal performance

**B8.2.4.2.1 Explain the importance of water and animal feed to the growth of animals.**
**Uses of feed that are commonly used for the growth and reproduction of animals are:**

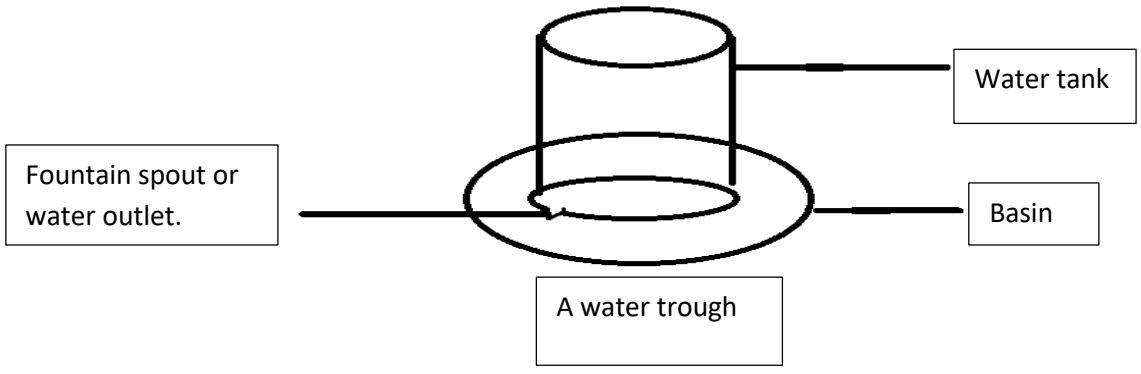
**1. Providing essential nutrients:** Feed is formulated to provide animals with the necessary nutrients such as proteins, carbohydrates, fats, vitamins, and minerals. These nutrients support growth and reproduction processes.
**2. Promoting muscle development:** Feed with adequate protein content helps animals build and maintain muscle mass, which is crucial for growth and reproduction.
**3. Supporting reproductive functions**: Certain feeds contain specific nutrients that support reproductive functions in animals. For example, feeds with high levels of omega-3 fatty acids can enhance fertility and reproductive performance.
**4. Enhancing bone and tissue development:** Feed that is rich in calcium, phosphorus, and other minerals helps in the development of strong bones and tissues, which is important for the growth and reproduction of animals.

**Uses of water that are commonly used for the growth and reproduction of animals are:**
1. Water helps animals stay hydrated.
2. Water helps animals digest their food.
3. Water is important for animals' body functions.
4. Water is necessary for animals to reproduce

**If animals don't have enough water,**

a. They can get sick,
b. Lose weight,
c. Have trouble reproducing,
d. And even die.

**Effects dehydration in farm animal**
1. Reduced feed intake and weight gain.
2. Decreased milk production in dairy animals.
3. Impaired digestion and nutrient absorption.
4. Heat stress and decreased ability to regulate body temperature.
5. Increased risk of urinary calculi in male ruminants.
6. Reduced egg production and quality in poultry.

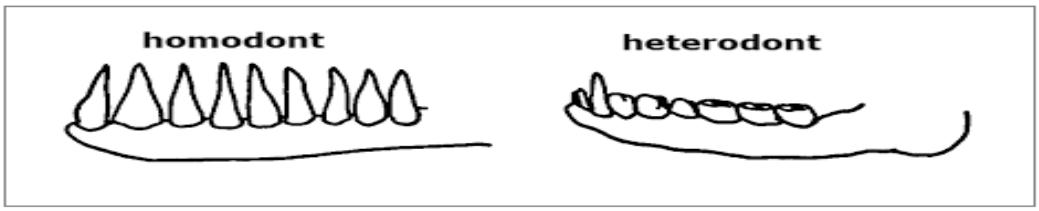



**Care and maintenance of water trough**
- 1. Regularly clean out physical debris from the water trough.
- 2. Disinfect the trough at least twice a year.
- 3. Store in cool and dry place
- 4. Remove particles that block the hole

**Importance of using water trough**
1. Provides consistent water supply for animals
2. Efficient water management
3. Convenient accessibility for animals
4. Promotes health and hygiene for animals

## STRAND 3 SYSTEMS
## SUB-STRAND 1 THE HUMAN BODY SYSTEM
## B8.3.1.1.1 Identify parts of mammalian tooth

**Dentition** refers to the shape, number and the arrangement of teeth in the mouth of an animal. The type of dentition in an animal is mainly suited [adapted] to the animal's mode/way of feeding or ingestion.
There are two jaws in humans, the upper and the lower jaws. The upper jaw is fix, whereas the lower jaw is movable. However, both jaws bear teeth. The teeth are used for chewing/mastication. The type and arrangement of the teeth in the buccal cavity is known as **dentition**.
Mammals have **heterodont dentition**. Under this type of dentition, the teeth has different sizes and shapes.
On the other hand, vertebrates such as fish, amphibians and reptiles have **homodont dentition**. In homodont dentition, all the teeth has the same size and shape. In human beings, children have **milk** or **deciduous** teeth. Milk teeth are fewer in number, smaller and temporary. The milk teeth appear first and are progressively replaced by the permanent teeth.
Adults have permanent teeth. Permanent teeth are bigger, having full complement of mammalian dentition. The different teeth in heterodont dentition are: **incisors, canines, premolars and molars.** The premolars and molars are called **cheek teeth.** Herbivores have a gap between their teeth. This gap is called the **diastema**.




### The structure of the tooth
The general structure of all types of teeth have two main parts, the crown and the root. The crown the part of the tooth which shows above (upper) the gum. The root is embedded in a cup-like socket of the jaw bone. The meeting point of the two parts of the tooth, crown and root, is called the neck.

**Structure of the tooth**

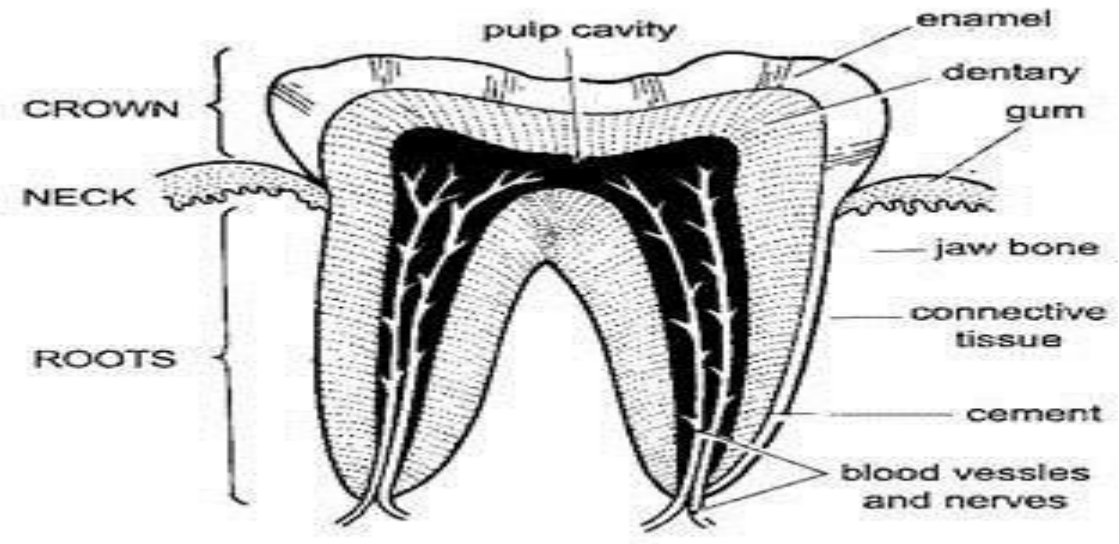


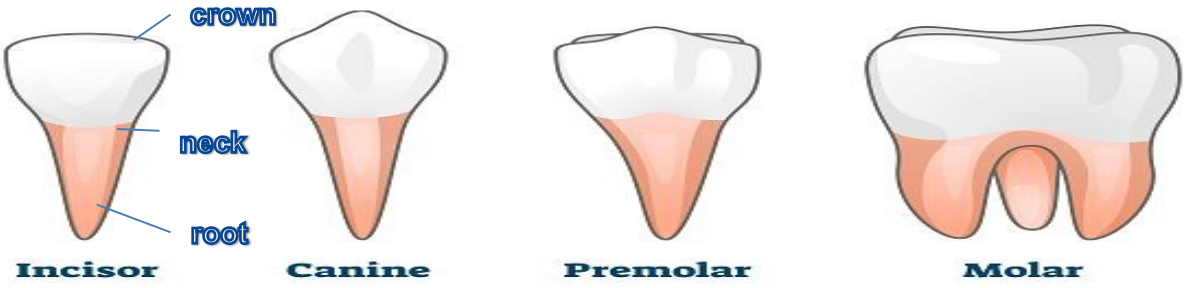

Fig. 33.6. V.S. of a human molar tooth.

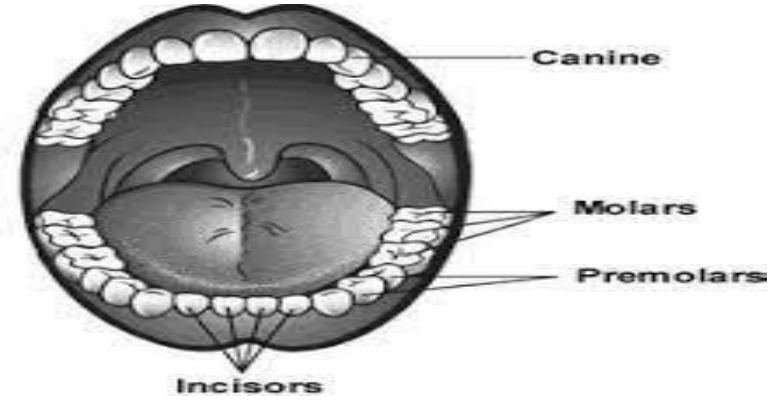
**The tooth is composed of different parts, each with its own specific function. Here are the main parts of a tooth and their functions:**

**1. Crown:** This is the visible part of the tooth above the gum line. Its function is to help with biting, chewing, and tearing food.
**2. Enamel:** This is the outermost layer of the tooth crown and is the hardest substance in the human body. It protects the tooth from wear and tear caused by chewing and provides a smooth surface for biting and chewing.
**3. Dentine:** This is the layer beneath the enamel and makes up the majority of the tooth structure. Dentin is not as hard as enamel but still provides support and protection to the innermost part of the tooth.
**4. Pulp cavity:** This is the innermost part of the tooth, located in the center of the crown and root. It contains blood vessels, nerves, and connective tissue. The pulp provides nourishment to the tooth and helps in the formation and repair of dentin.
**5. Root:** This is the part of the tooth that is embedded in the jawbone. It anchors the tooth in place and provides stability.
**6. Cement**: This is a layer of connective tissue that covers the root of the tooth. It helps to attach the tooth to the surrounding bone and provides protection.
**7. Periodontal ligament:** This is a group of fibers that attach the tooth to the surrounding bone. It acts as a shock absorber and helps to hold the tooth in place.

**Types of teeth & their functions**
There are four types of teeth that can be found in mammalian mouth. They are;
**A. Incisor** **b. Canine** **c. Premolar** **d. Molar**

**Structures of the four types of teeth**




**NB: The functions of the carnassial teeth is used for cutting or shearing flesh from bones.**

| Types of teeth | Location | Function | Description of it structural adaptation. |
|---|---|---|---|
| Canine | Situated one on each either side of the incisors in each jaw. | For tearing (meat). | Conical and bluntly pointed. |

| | | | |
|---|---|---|---|
| Molar | These are the last three in each jaw. | For grinding or chewing or crushing. | Flat surface with two or more points or cusps or ridges. |
| Premolar | The two premolars are situated next to canine. | For grinding or chewing or crushing. | Flat surface with one or more points or cusps or ridges. |
| Incisor | Situated at the front of the buccal cavity. | For cutting or biting. | Chisel shaped with sharp flat edges. |

**Differences between Canine and Molar**

| Canine | Molar |
|---|---|
| Bluntly pointed. | Flat surface (with few points). |
| Small in size | Large or broad |
| Has a single root | Has three roots. |

**Measures to ensure proper dental hygiene**

- Teeth must be used in the proper way.
- Regular brushing of teeth to avoid decay.
- Regular examination of teeth by an expert.
- Intake of refined carbohydrates such as toffees and chocolate must be avoided.

**Diseases of the tooth [teeth]**

There are many diseases that can affect the teeth, but the common among them includes;

- Tooth decay [dental caries],
- Plaque and
- Gum [periodontal] disease.

**Tooth decay** occurs when small holes [cavities] are created in the enamel of the tooth. This is due to the accumulation of acids as a result of the action [activities] of some bacteria on sugary foods [sweets] that are left [found] on the enamel for a long time.

**Conditions that encourage tooth decay**

- Intake of too much sugary foods or cakes.
- Failure to brush teeth regularly.
- Misuse of the teeth which leads to injuries to the gum.
- Eating too cool or hot food.
- Bacteria action

**Ways of preventing tooth or dental decay**

A. Regular brushing of tongue.
**B.** Regular dental checkup.
C. Avoiding eating too much sugary food or sweets.
**D.** Brushing teeth after meals

**Plaque** consists of a sticky film layer deposit that is made up of food remains on the teeth which has been mixed with saliva by the action [activities] of bacteria and other micro-organisms.

**Treatment of plaque**

Plaque can easily be removed by the proper brushing of the teeth using a good tooth paste and brush.
Note: If plaque is left unchecked as a result of a prolonged improper teeth brushing, it may develop and grow into the gum to cause [bring about] periodontal [gum] disease

**Periodontal [gum] disease**

Gum disease which is an advanced form of plaque occurs when bacteria causes the gum to be inflamed; i.e to feel painful when it is touched and to also bleed [discharge blood] frequently. Periodontal disease may also lead to bad breath and the loss of teeth if it is not treated.

**Treatment of gum disease**

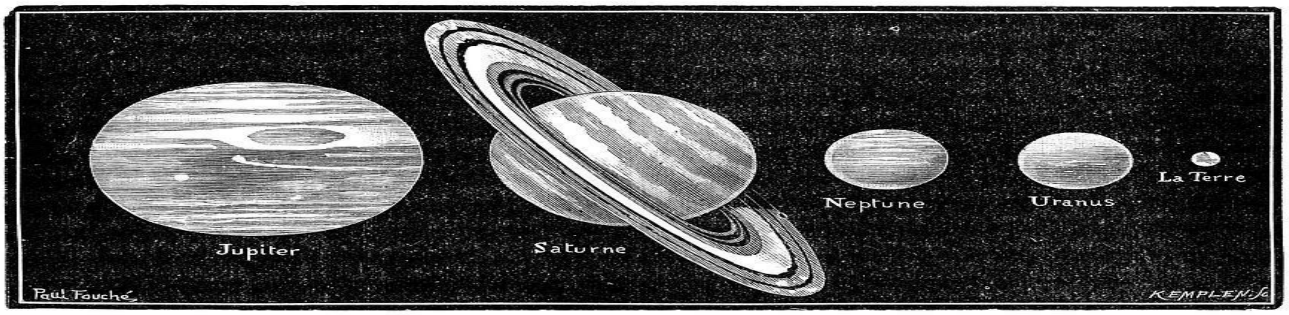
1. The teeth should be brushed properly in order to prevent the accumulation of bacteria or plaque.
2. The teeth should be brushed at least twice daily; i.e. Early in the morning and in the evening, before going to bed.

## STRAND 3 SYSTEMS
## SUB-STRAND 2 THE SOLAR SYSTEM
### B8.3.2.1.1 identify the outer planets of the solar system and describe their properties

**A galaxy** is a large system of stars, gas, dust, and other celestial objects that are held together by gravity. Galaxies come in different shapes and sizes, and they can contain billions or even trillions of stars. Our own galaxy, the Milky Way, is just one of many galaxies in the universe. Galaxies can be spiral-shaped, like the Milky Way, or they can be elliptical or irregular in shape. They are fascinating and beautiful structures in the vastness of space.
**Stars** *are heavenly bodies that are made up mostly of burning gases.*
**The Milky Way is a galaxy**, It is the galaxy that contains our solar system, which includes the Sun, Earth, and all the other planets. The Milky Way is a spiral-shaped galaxy, and it is home to billions of stars, including our own Sun. It is called the Milky Way because it appears as a milky band of light in the night sky.

**The solar system** is composed of the sun, eight planets (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune), numerous moons, asteroids, comets, and other celestial objects. The sun is at the center of the solar system, and the planets orbit around it.

**Outer planets**, also known as gas giants, are a group of planets in our solar system that are located beyond the asteroid belt. These planets include **Jupiter, Saturn, Uranus, and Neptune**. They are called gas giants because they are primarily composed of gases, such as hydrogen and helium, and have thick atmospheres.




**A. Jupiter** is one of the outer planets or gas giants in our solar system. It is the largest planet and is known for its distinctive bands of clouds and its Great Red Spot, which is a giant storm.

**Reason why Jupiter does not support life.**

Jupiter does not support life as we know it because it lacks certain conditions necessary for life to exist.Firstly, Jupiter is a gas giant with no solid surface, only a dense atmosphere. This means there is no stable ground for organisms to live on.
Additionally, the extreme temperatures, high levels of radiation, and intense atmospheric pressure on Jupiter make it inhospitable for life as we understand it.

**Features of Jupiter**

- Jupiter is very big.
- It has colorful bands.
- It has a big storm called the **Great Red Spot**.
- It is made mostly of gas.

**B. Saturn** is another outer planet or gas giant in our solar system. It is known for its beautiful rings, which are made up of ice and rock particles. Saturn is the second largest planet and has a similar composition to Jupiter, being mostly made up of gases like hydrogen and helium.

**Reason why Saturn does not support life**

Saturn does not support life as we know it because it lacks the necessary conditions for life to exist.
Similar to Jupiter, Saturn is a gas giant with no solid surface, only a dense atmosphere.
It also has extreme temperatures, high levels of radiation, and intense atmospheric pressure, which make it inhospitable for life as we understand it.

## Features of Saturn

**A.** Saturn has beautiful rings.
**B.** It is the second largest planet.
**C**. It is made mostly of gas.
**D.** It has a yellowish color.

**C. Uranus** is the seventh planet from the Sun and is a gaseous ice giant with a bluish-green hue, surrounded by faint rings and numerous small moons. Uranus appears ***bluish-green in color due to the presence of methane in its atmosphere.*** Methane gas in the upper atmosphere absorbs red light, allowing the blue and green wavelengths to be scattered, giving the planet its distinctive color. This is similar to how Earth's atmosphere scatters blue light, giving our sky its blue color. The specific combination of gases and their interaction with sunlight gives Uranus its unique appearance. Uranus is the seventh planet from the sun in our solar system. It is an ice giant, similar to Neptune, and is the third-largest planet by diameter. Uranus is unique because it rotates on its side, making its axis nearly parallel to its orbit around the sun. This unique tilt gives Uranus extreme seasons, with each pole experiencing 42 years of continuous sunlight followed by 42 years of darkness. The planet is composed mostly of hydrogen and helium, with a small rocky core. Uranus also has a set of thin rings and 27 known moons, all named after characters from the works of William Shakespeare and Alexander Pope.

## Reason why Uranus does not support life

Uranus does not support life primarily because of its extreme conditions.
The planet has a harsh and inhospitable environment with extremely low temperatures, reaching as low as -224 degrees Celsius (-371 degrees Fahrenheit).
Additionally, Uranus lacks a solid surface and has a thick atmosphere composed mainly of hydrogen, helium, and methane. These factors make it impossible for life as we know it to exist on Uranus.

## Characteristics of Uranus

1. Uranus is the seventh planet from the Sun.
2. Uranus is a gas giant, meaning it is mostly made up of gases like hydrogen and helium.
3. Uranus has a blue-green color, which is caused by the presence of methane in its atmosphere.
4. Uranus has a unique feature called axial tilt, where its axis of rotation is tilted at an extreme angle compared to other planets.

**D. Neptune** is the eighth and farthest known planet from the Sun in our solar system. It is a gas giant, similar to Uranus, and is primarily composed of hydrogen and helium. ***Neptune is known for its beautiful blue color, which is caused by the presence of methane in its atmosphere***. It has a system of rings and a total of 14 known moons. Neptune is also known for its strong winds, with the fastest recorded wind speeds in the solar system.

## Reason why Neptune does not support life

Neptune does not support life primarily because of its extreme conditions. Similar to Uranus, Neptune has a harsh and inhospitable environment with extremely low temperatures, reaching as low as -218 degrees Celsius (-360 degrees Fahrenheit).
Additionally, Neptune is a gas giant with no solid surface, and its atmosphere is composed mainly of hydrogen, helium, and methane. These factors make it impossible for life as we know it to exist on Neptune.

## Characteristics of Neptune:

1. Neptune is the eighth planet from the Sun.
2. Neptune is a gas giant, which means it is made mostly of gases like hydrogen and helium.
3. Neptune has a beautiful blue color, caused by the methane gas in its atmosphere.
4. Neptune has strong winds, with some of the fastest winds in the solar system.

## Differences between the inner planets and the outer planets:

1. Inner planets are smaller and rocky, while outer planets are larger and made mostly of gases.
2. Inner planets are closer to the Sun, while outer planets are farther away.
3. Inner planets have shorter years, or the time it takes to orbit the Sun, while outer planets have longer years.
4. Inner planets have fewer moons, while outer planets have more moons.

## STRAND 3 SYSTEMS
## SUB-STRAND 3 ECOSYSTEM
### B8.3.3.1.1 Explore the feeding relationships within an ecosystem

**How life on earth will be like without the sun.**
Life on Earth would not be possible without the sun. The sun provides heat and light, which are essential for the survival of all living organisms. It plays a crucial role in photosynthesis, the process by which plants convert sunlight into energy. Without the sun, plants would not be able to produce oxygen, and the food chain would collapse. Additionally, the sun's gravitational pull keeps the Earth in its orbit, maintaining stable temperatures and climate conditions. In summary, life on Earth would not be sustainable without the sun.

**Effects on Earth without the sun:**
1. No light: Without the sun, it would be very dark on Earth all the time.
2. No heat: The Earth would become very cold without the sun's warmth.
3. No plants: Plants need sunlight to grow, so there would be no trees, flowers, or grass.
4. No food: Without plants, animals wouldn't have anything to eat, and we wouldn't have food either.
5. No oxygen: Plants produce oxygen through photosynthesis, so without them, there would be less oxygen in the air.
6. No seasons: The sun helps create different seasons, like summer and winter. Without it, there would be no changes in weather throughout the year.

**A food chain** is a linear sequence of organisms, where each organism is a source of food for the next organism in the chain. It represents the flow of energy and nutrients from one organism to another in a specific ecosystem. A food chain typically starts with a producer, such as a plant, which is then consumed by a primary consumer, which is then consumed by a secondary consumer, and so on. It helps us understand the transfer of energy and the relationships between different organisms in a simplified manner.

**Consumers** are organisms that obtain their energy by consuming other organisms. They are also known as heterotrophs, as they *cannot produce their own food through photosynthesis like producers (such as plants) can.* Consumers can be classified into different categories based on their feeding habits. For example, herbivores are consumers that eat only plants, carnivores are consumers that eat other animals, and omnivores are consumers that eat both plants and animals. Decomposers, such as bacteria and fungi, are also considered consumers as they obtain energy by breaking down dead organic matter. These different types of consumers play important roles in maintaining the balance of energy and nutrients within an ecosystem.

**Primary consumers** are organisms that directly consume producers, such as plants or algae. They are also known as herbivores. Examples of primary consumers include rabbits, deer, and cows. They primarily feed on plants and are herbivores.

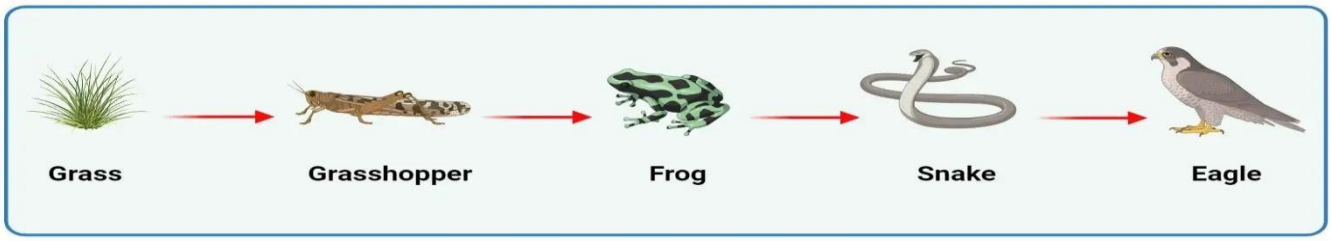
**Secondary consumers** are organisms that feed on primary consumers. They are also known as carnivores or omnivores. Examples of secondary consumers include wolves, lions, and bears. They feed on primary consumers, such as rabbits or deer, and are carnivores or omnivores.

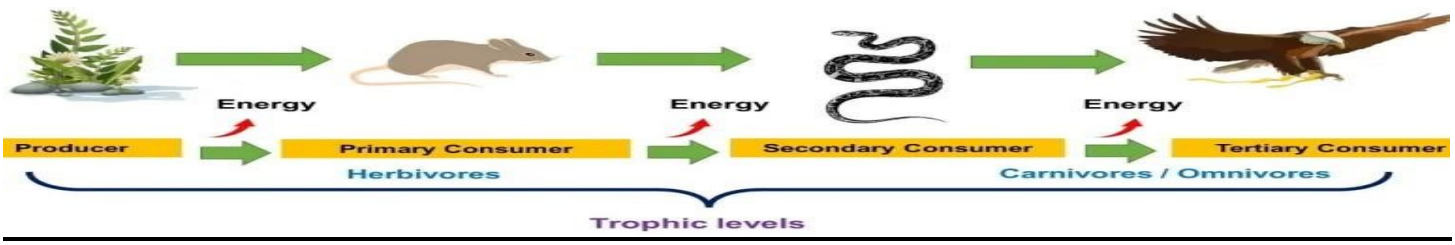
**Tertiary consumers** are organisms that feed on secondary consumers. They are usually apex predators and are at the top of the food chain. Tertiary consumers are often apex predators, such as sharks, eagles, or tigers. They feed on secondary consumers and are at the top of the food chain.

**1. Herbivores:** These are consumers that eat only plants. They obtain their energy by consuming leaves, stems, fruits, or other parts of plants. Examples include cows, rabbits, and deer.
**2. Carnivores:** These are consumers that eat other animals. They obtain their energy by consuming the flesh of other animals. Examples include lions, wolves, and snakes.
**3. Omnivores:** These are consumers that eat both plants and animals. They obtain their energy by consuming a combination of plant and animal matter. Examples include humans, bears, and raccoons.
**4. Scavengers:** These are consumers that feed on dead animals or decaying organic matter. They obtain their energy by consuming the remains of other organisms. Examples include vultures, hyenas, and some species of beetles.
**5. Decomposers:** These are consumers that obtain their energy by breaking down dead organic matter. They play a crucial role in recycling nutrients back into the ecosystem. Examples include bacteria and fungi.

**<u>There are a few rules to keep in mind when constructing a food chain:</u>**
1. The food chain always starts with a producer, which is usually a plant or algae that can produce its own food through photosynthesis.
2. The primary consumers, which are herbivores, feed on the producers.
3. The secondary consumers, which are carnivores or omnivores, feed on the primary consumers.
4. Tertiary consumers, which are often apex predators, feed on the secondary consumers.
5. Decomposers, such as bacteria and fungi, break down dead organisms and organic matter, returning nutrients to the soil or water and completing the food chain.

**Here are four different examples of food chains:**
**1. Grass → grasshopper → frog → snake → hawk**
In this food chain, grass is the producer, grasshopper is the primary consumer, frog is the secondary consumer, snake is the tertiary consumer, and hawk is the apex predator.
**2. Algae → zooplankton → small fish → large fish → shark**
In this marine food chain, algae is the producer, zooplankton is the primary consumer, small fish is the secondary consumer, large fish is the tertiary consumer, and shark is the apex predator.
**3. Acacia tree → giraffe → lion**
In this african savanna food chain, the acacia tree is the producer, giraffe is the primary consumer, and lion is the secondary consumer.
**4. Sunflower → bee → bird → fox**
In this food chain, sunflower is the producer, bee is the primary consumer, bird is the secondary consumer, and fox is the tertiary consumer.

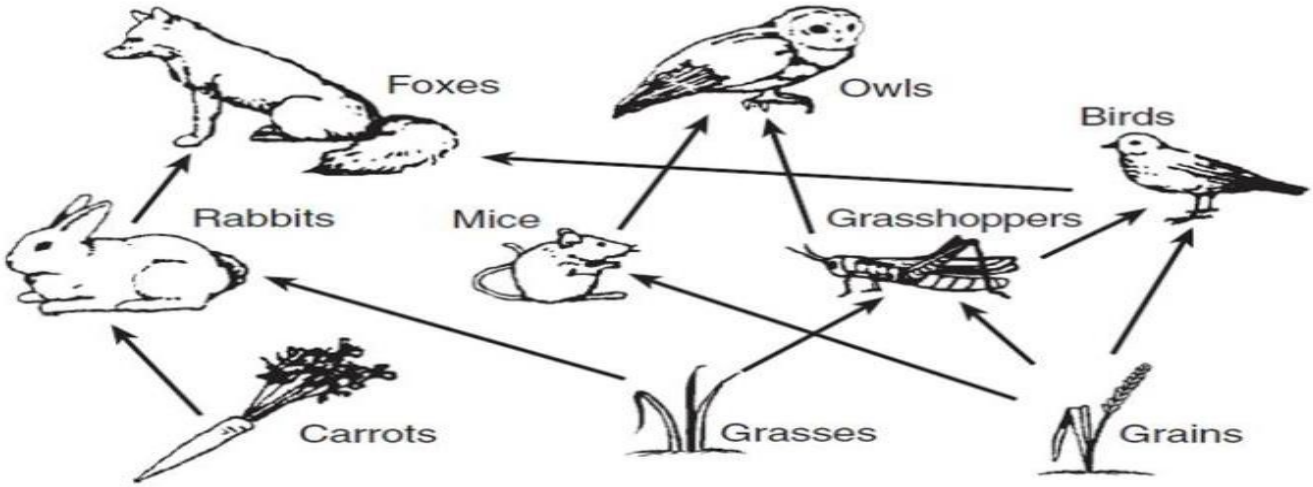


**A food web** is a representation of the feeding relationships between different organisms in an ecosystem. It shows how energy and nutrients flow through the ecosystem, with arrows indicating the direction of energy transfer from one organism to another. It includes producers, consumers, and decomposers, and helps us understand the complex interactions and dependencies between different species in an ecosystem.

**The rules for constructing a food web include the following:**

1. Identify the organisms: Start by identifying the different organisms that are part of the ecosystem you are studying. This includes both producers (plants) and consumers (animals).
2. Determine the feeding relationships: Next, determine the feeding relationships between the organisms. This involves understanding who eats whom in the ecosystem.
3. Create the web: Once you have identified the organisms and their feeding relationships, you can start constructing the food web. Use arrows to show the flow of energy from one organism to another. Arrows should point from the organism being eaten to the organism doing the eating.
4. Include all trophic levels: Make sure to include all trophic levels in the food web, from primary producers (plants) to primary consumers (herbivores) to secondary consumers (carnivores) and so on.
5. Consider energy flow: Remember that energy flows through the food web, starting from the sun and moving through the different organisms. Show this energy flow in your food web.




**Importance of food web and food chain**

1. Shows how plants and animals are connected
2. Helps maintain balance in ecosystems
3. Ensures all living things have enough to eat
4. Demonstrates the interdependence of different species

| Difference Between Food Chain And Food Web | |
|---|---|
| **Food Chain** | **Food Web** |
| A linear pathway showing the flow of energy | A multitude of networks showing the flow of energy |
| An organism of higher level trophic feeds on a specific organism of lower trophic level | An organism of a higher trophic level has access to more members of a lower trophic level. |
| Does not affect the adaptability and competitiveness of organisms. | It has a role in improving the adaptability and competitiveness of an organism. |

## STRAND 3 SYSTEMS
## SUB-STRAND 4 FARMING SYSTEMS

**B8.3.4.1.1 Identify and describe the types of crops, animals and land combinations for the different farming systems**.

**In Ghana, various farming systems are practiced, each with specific combinations of crops, animals, and land use**.
Here are some of the main farming systems and their characteristics:

1. Mixed Crop-Livestock Farming:
   - Crops: Maize, cassava, yam, and vegetables.
   - Animals: Poultry, goats, and sheep.
   - Land Use: Utilizes both arable land for crop cultivation and grazing areas for livestock.

2. Tree Crop-Livestock Farming:
   - Crops: Cocoa, oil palm, and rubber.
   - Animals: Poultry and small ruminants.
   - Land Use: Involves the cultivation of tree crops alongside the rearing of livestock in agroforestry systems.

3. Irrigated Rice Production:
   - Crops: Rice.
   - Animals: Fish (integrated fish farming in rice paddies).
   - Land Use: Focuses on the cultivation of rice in irrigated areas with integrated fish farming for protein production.

4. Shea Butter Agroforestry Systems:
   - Crops: Shea trees.
   - Animals: Small ruminants (e.g., goats).
   - Land Use: Involves the cultivation of shea trees alongside small ruminant rearing in agroforestry settings.

5. Cocoa-Based Agroforestry:
   - Crops: Cocoa and other shade-tolerant crops.
   - Animals: Poultry and small livestock.
   - Land Use: Integrates cocoa cultivation with shade-tolerant crops and small-scale animal husbandry.

**Farming system** is used to describe an enterprise which may be entirely animal- based, crop-based or a mixture of the two.
**The different types of farming systems practiced in Ghana include:**

| | | |
|---|---|---|
| 1. Shifting cultivation | 3. Crop Rotation | 5. Mixed Farming |
| 2. Land Rotation | 4. Mixed Cropping | 6. Organic Farming. |

**Shifting cultivation.** This is a system of farming in which the farmer cultivates a piece of land for some time, the land when it loses its fertility together with his settlement. The farmer may come back to cultivate the old land later.

**Advantages of Shifting cultivation**
1. Land previously used is allowed to fallow so as regain its fertility.
2. Farmer spends little or nothing in improving the soil fertility.
3. The farmer could grow crops on any new land he moves to.

**Disadvantages of Shifting cultivation**
1. Due to increasing population and resultant pressure on land, this system is difficult to practice.
2. The would always have to move or relocate his household.
3. This type of farming system is expensive because of the constant clearing of new land.

4. Erosion can start on abandoned soil.
5. It destroys the natural forest 6. Yield is very low because farm inputs which improve yields are not used.

**Land rotation**.This is a system of farming in which a farmer cultivates a piece of land for some time and leaves it to clear a new land when the old land becomes less fertile. The farmer moves to the new land without moving his settlement.

**Advantages of Land rotation**

1. The land regains its fertility after the fallow period.
2. Disease build up is reduced.
3. Pest attack is reduced.

**Disadvantages of land rotation**

- It destroys the virgin forest.
- Land rotation cannot be practiced in areas where the land is scarce.
- Commercial production is discouraged.

**Crop rotation** is the practice of growing a series of dissimilar or different types of crops in the same area in sequenced seasons.

**Principles of crop rotation**

- Crops with deep roots should be followed by crops with shallow roots.
- Crops which use much more nutrients should be followed by crops that use less nutrients.
- Crops that come from the same family, e.g. Rice and maize, must not follow one another.
- Legumes should be included in the rotation plan.

**Reasons why legumes are included in crop rotation**

- Legumes improve the structure of the soil.
- Legumes add nitrogen to the soil thereby improving soil fertility.
- They control soil erosion when used as cover crops. E.g. Cowpea.
- There is reduction in labour use, e.g. No frequent land clearing.

**Reasons why it is important for farmers to keep records during crop production**

- Records show how much tax to pay.
- Helps the farmer to plan or budget for the future or making management decisions.
- Helps to know total investment made into the farm business.
- It helps the farmer to obtain loans to determine the amount of yield or productivity made.
- To measure progress in crop production.
- For educating new generation of farmers.

**Advantages of crop rotation**

1. There is reduction of total crop failure
2. Soil fertility is maintained because of the inclusion of leguminous plants
3. Crop rotation controls soil erosion.
4. It breaks pest cycle
5. It breaks disease cycle 6. It ensures effective use of labour.

**Disadvantages of crop rotation**

1. Special skill is required in carrying out this type of farming system.
2. Cultural practices are difficult to carry out on the same piece of land because different crops are involved.

**Mixed cropping**, also known as inter-cropping or co-cultivation, is a type of farming that involves planting two or more of plants(crops) simultaneously in the same field.

**Advantages of mixed cropping**

1. Different crops may be harvested at different times. This helps the farmer to get food over a long period.
2. Since different crops are grown, pests and diseases may not spread easily.
3. Where cover crops or legumes are grown, they soil fertility.

**Disadvantages of mixed cropping.**

1. The crops may compete for nutrients, water, light and space for survival.
2. Different fertilizers may be needed in some cases, for different crops. This could increase the cost of production.
3. Mechanization is difficult.
4. Improper spacing may lead to shading of other crops.

**Mixed farming** is the cultivation of crops along with rearing of animals for meat or milk on the same farm.

**Advantages of mixed farming.**

1. The is regular supply of food for the farmer and his family.
2. The fertility of the soil is improved by the use of farm yard manure.
3. There is no need for the farmer to shift to a new piece of land since there is less likelihood of low soil fertility.
4. Plant matter may be used to feed animals while animal dung or droppings may also be used to fertilize crops field. This reduces the cost of production since less feed is purchased for animals while the soil is also fertilized with manure from animals.

**Disadvantages of mixed farming.**

1. The farmer may have divided attention for keeping both crops and animals.
2. It requires a lot of skills in managing crops and animals.
3. Animals usually destroy crops when they are not well confined.

**Organic farming** is defined as production of crop, animal, and other products without the use of synthetic chemical fertilizers and pesticides, transgenic species, or antibiotics and growth enhancing steroids, or other chemicals.

**Advantages of organic farming**.

I. Organic produce attracts high price in foreign markets.
Ii. Food produced are free from harmful chemicals.
Iii. Organic farming is labour intensive.
Iv. Organic farming cannot be used to produce food on large scale.

**Subsistence Farming**: This is the most common farming system in Ghana, where farmers grow crops and raise livestock primarily to meet the needs of their own families.
The advantage is that it ensures food security for the farmer's household.
The disadvantage is that it often leads to low productivity and limited income generation

**Commercial Farming**: This type of farming focuses on producing crops or raising livestock for sale in the market.
The advantage is that it can generate higher income and contribute to the country's economy.
Commercial farming requires significant investment, access to markets, and technical knowledge, which can be a disadvantage for small-scale farmers.

**Important reasons why farming systems are important:**

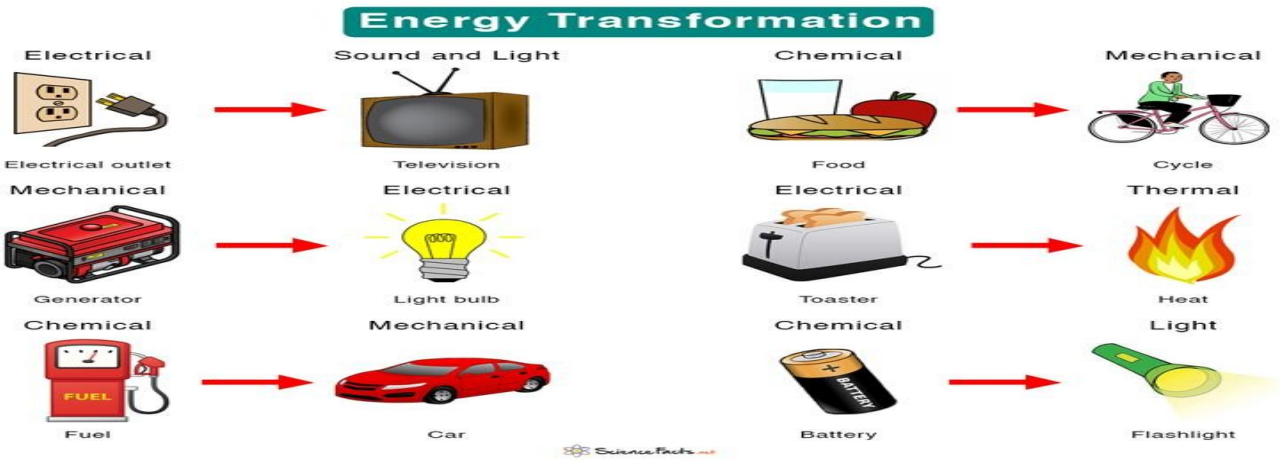
1. Farming system serves as a source of lively-hood.
2. It provides employment opportunities.
3. It contributes to the development of the economy.
4. It provides industries with raw materials to the such cocoa, rubber, cotton, tobacco, etc

## STRAND 4 FORCES AND ENERGY
## SUB-STRAND 1 ENERGY
## B8.4.1.1.1Describe energy conversion

**Energy conversion** is the process of changing one form of energy into another, such as converting solar energy into electrical energy through solar panels.

Energy can be converted from one form to another through various processes. The most common way is through the principle of conservation of energy, which states that energy cannot be created or destroyed, but only transformed from one form to another. For example, when a car engine burns fuel, chemical energy is converted into mechanical energy to move the car. Similarly, when a light bulb is turned on, electrical energy is converted into light and heat energy. These conversions can occur through processes such as combustion, electrical generation, or mechanical work.

**Examples of energy transformation**

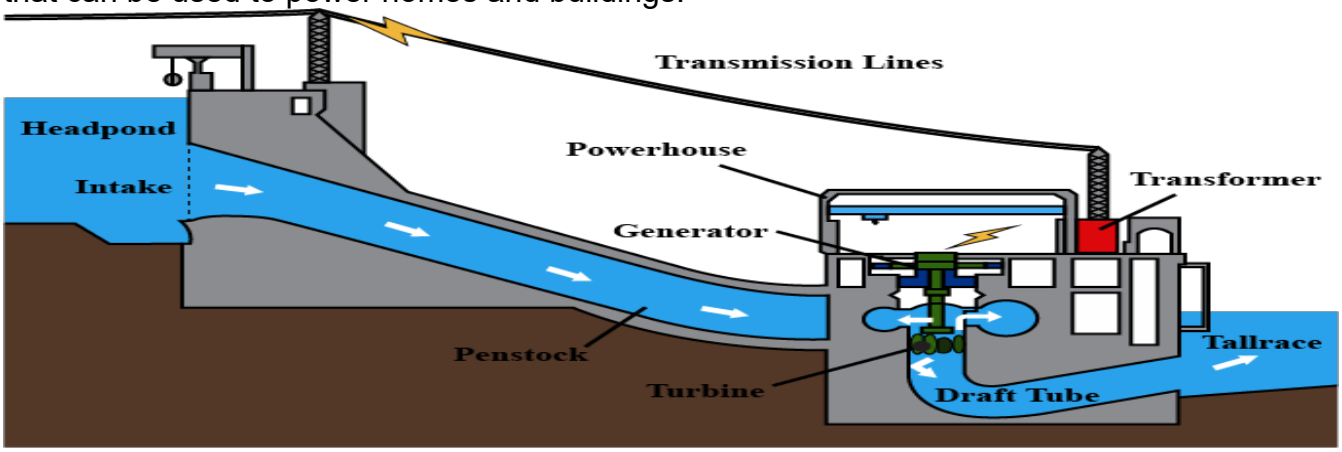



| Scenario | Energy conversions involved |
|---|---|
| ***Rubbing both hands together for warmth*** | Kinetic Energy to Thermal Energy |
| ***A falling object speeding up*** | Gravitational Potential Energy to Kinetic Energy |
| ***Using battery-powered torchlight*** | In the battery: Chemical to Electrical Energy<br>In the bulb: Electrical to Radiant Energy |
| ***In Geothermal Power Plant*** | Heat Energy to Electrical Energy |
| ***In Thermocouple*** | Heat Energy to Electrical Energy |
| ***In Hydroelectric Dams*** | potential energy to kinetic energy to Electric Energy |
| ***In Electric Generator*** | Kinetic energy / Mechanical Energy to Electric Energy |
| ***In Windmills*** | Wind Energy to Mechanical Energy or Electric Energy |
| ***In OTEC (Ocean Thermal Energy Conversion)*** | Heat Energy to Electric Energy or Mechanical Energy |
| ***Using Microphone*** | Sound Energy to Electric Energy |
| ***Photosynthesis in Plants*** | Solar Energy to Chemical Energy |
| ***In Piezoelectrics*** | Strain Energy to Electric Energy |
| ***In Electric lamp*** | Electric Energy to Heat Energy and Light Energy |
| ***Burning of wood*** | Chemical energy to Heat and Light Energy |

| | |
|---|---|
| ***In Fuel cells*** | Chemical Energy to Electric Energy |
| ***In steam engine*** | The heat energy to Mechanical Energy |
| ***In Electric heater*** | Electric Energy to Heat |

**Explain the processes that a dammed river goes through to produce electricity.**

**A. Hydroelectric power** is produced by using the energy from flowing or falling water, such as a river or a waterfall, to turn turbines. These turbines then spin generators, which create electricity that can be used to power homes and buildings.




**Some challenges that may be faced in hydroelectricity production include**

A. The need for a suitable location with a sufficient water source,
B. Potential environmental impacts on aquatic ecosystems,
C. The high initial cost of building dams and power plants.

**Advantages of using hydroelectric power.**

It is a renewable energy source, meaning it won't run out.
It produces clean electricity without emitting harmful greenhouse gases.
It can also provide a reliable and consistent source of power, as long as there is a steady supply of water.

**Harnessing natural forms of energy into other forms** involves utilizing the energy available in nature and converting it into a more useful or desired form. There are several ways to do this, depending on the specific natural energy source. For example, solar energy can be harnessed through the use of solar panels, which convert sunlight into electricity. Wind energy can be harnessed using wind turbines, which convert the kinetic energy of the wind into electrical energy. Hydropower involves harnessing the energy of flowing or falling water to generate electricity using turbines. Geothermal energy can be harnessed by tapping into the heat stored beneath the Earth's surface and converting it into electricity. Biomass energy involves converting organic materials, such as wood or agricultural waste, into heat or electricity through processes like combustion or fermentation. These are just a few examples of how natural forms of energy can be harnessed and converted into other forms for various purposes.

**B8.4.1.2.1 Describe renewable and non-renewable forms of energy.**

**A. Renewable sources of energy**

**Renewable energy comes from natural sources that are constantly replenished, such as sunlight, wind, and water.** Renewable sources of energy refers to all those energy sources that are inexhaustible in supply or cannot get finished [depleted] with time as a result of continuous [repeated] use. The examples of renewable energy sources include wind, solar, hydroelectric, and bioenergy.

**B. Non - renewable sources of energy**

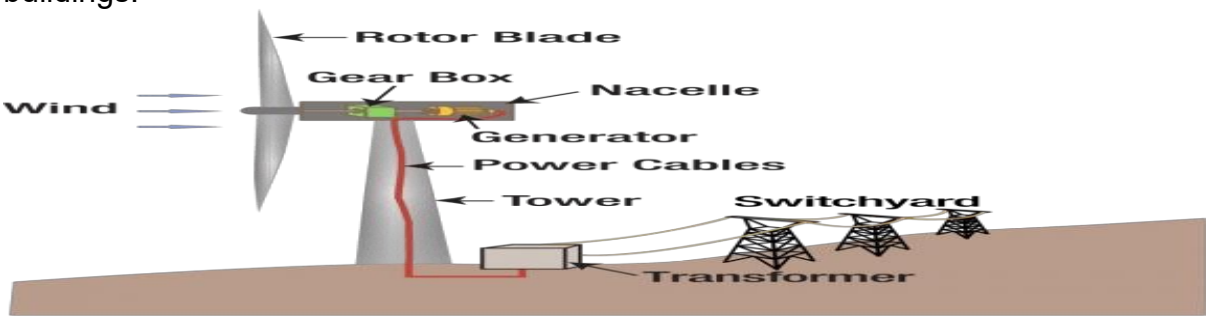
**Non-renewable energy comes from sources that are finite and cannot be easily replaced, such as fossil fuels like coal, oil, and natural gas**. Non - renewable sources of energy refers to all those energy sources that are exhaustible in supply or can get finished [depleted] with time as a result of continuous [repeated] use.

**Advantages of solar energy over the use of fossil fuel as source of energy**

| Renewable energy resources | Non-renewable energy resource |
|---|---|
| Energy independent | Depends very much on other energy sources. |
| Production does not pollute the environment | Production involves a lot of emissions which pollutes the environment. |

**How to used the renewable energy source to produce energy**

**A. Wind energy** is produced by using the power of the wind to turn large turbines. These turbines are connected to generators, which create electricity that can be used to power homes and buildings.



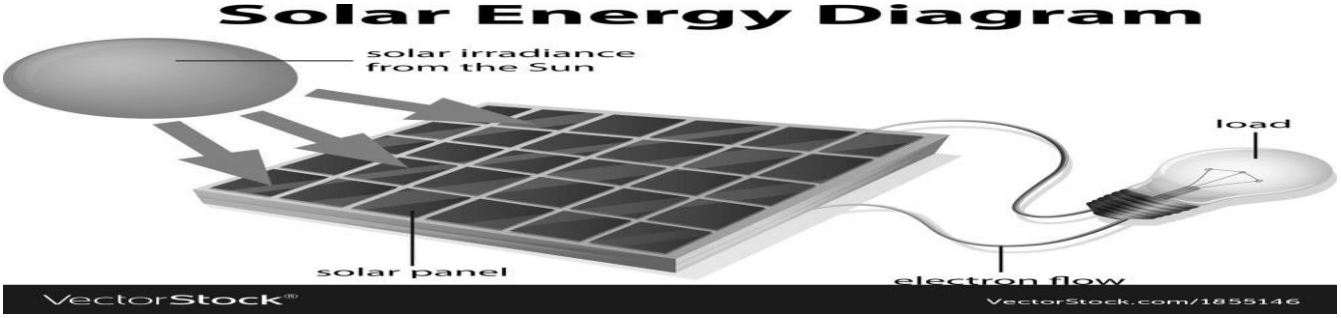

**Some challenges that may be faced in wind energy production include**

- The need for a suitable location with consistent and strong winds,
- Potential impacts on wildlife and their habitats,
- The initial cost of building and maintaining wind turbines.

**There are several advantages of using wind energy.**

- It is a renewable energy source, meaning it won't run out.
- It produces clean electricity without emitting harmful greenhouse gases.
- It can also provide a reliable source of power, as long as there is a steady supply of wind.
- Wind energy can help reduce our dependence on fossil fuels and contribute to a healthier environment.

**B. Solar energy** is produced through a process called photovoltaic conversion. It involves the use of solar panels, which are made up of photovoltaic cells. These cells are made of semiconductor materials, such as silicon, that can convert sunlight directly into electricity. When sunlight hits the solar panels, the photons in the sunlight excite the electrons in the semiconductor material, creating an electric current. This current can then be used to power various devices or stored in batteries for later use.



**How solar energy is used to generate electricity.**

- A photovoltaic cell or solar cell collects the sun‘s energy.
- The energy removes an electron from the cell or causes photoelectric effect.
- The electron when moves and this movement of electrons constitute electric current.

OR

Solar energy is produced by capturing the energy from sunlight using solar panels, which contain photovoltaic cells. When sunlight hits the cells, it creates an electric field that generates electricity.

**Solar energy** is the energy obtained from the sun.

**Solar cells** convert the sun‘s energy into **electrical energy**. The ultimate source of energy on the earth is the sun.

**Photovoltaic module of a solar panel** converts heat from the solar radiation into electrical energy.

**The function of the solar thermal collector in a solar panel** is to trap heat from the solar radiations.

**Uses or Applications of Solar Energy**

- It is use to heat homes and commercial buildings.
- For drying of crops
- Heating water for agricultural industry
- To provide hot water for the commercial sector
- To ventilate buildings
- To generate electricity.

**Applications of Solar Energy in practical daily activities**

- Drying clothes.
- Heating water for bathing
- Drying crops for preservation
- Cooking e.g. Corn, fish etc. Using solar cookers.
- Boiling of eggs.

**Advantages of Solar Energy**

- Solar power is less-emission.
- It is suitable for remote areas that are not connected to energy grids.
- Solar panels contain no moving parts and thus produce no noise.
- In the long run, solar power is economical.
- Solar power is reliable.
- Low maintenance cost.

**Uses of Solar energy**

- It is weather- dependent
- Solar energy storage is expensive.
- Uses a lot of space.
- It is associated with pollution.

**Managing renewable energy sources involve**

1. Identify renewable energy sources like sunlight, wind, and water in your area to understand their potential for generating clean energy.
2. Practice energy conservation by turning off lights, unplugging devices, and using energy-efficient appliances to reduce overall energy consumption.
3. Learn about solar panels and how they can harness sunlight to generate electricity for homes and communities.

4. Understand how wind turbines work to convert wind energy into electricity and explore the concept of wind farms.
5. Discuss the importance of considering the environmental impact of renewable energy projects to balance energy needs with environmental conservation.

## B8.4.1.3.1 Discuss the differences and the relationship between heat and temperature.

### Heat energy
**Heat i**s a form of energy that is transmitted from one point to another due to a temperature difference between the points. **OR**
Heat is the amount of energy which tells the amount thermal energy contained in a body.

### Why heat is a form of energy
Heat is the total amount of energy possessed by the molecules in a piece of matter. This energy is both kinetic and potential energy.

### Sources of heat energy
Fire sun, electricity, chemical reactions, oil, and friction (e.g. Rubbing the palm together).

### Effects of heat on a substance
- ✓ Rise in temperature
- ✓ Change in shape
- ✓ Change in state or form
- ✓ Change in volume or size

**Note: Calorimetry** is the measurement of heat energy in a substance. The **calorimeter** is a metal container (often thin-walled) used to hold liquids in heat experiments.

### Temperature
**Temperature** is the degree of hotness or coldness of a substance.
Temperature scales commonly used now are the Celsius ( ) and thermodynamic (K) scale

### Differences between heat and temperature

| Heat | Temperature |
|---|---|
| It is a form of energy | It measures the degree of hotness or coldness |
| It is measured in joules. | It is measured in Celsius, kelvin or farad. |
| It is measured with a calorimeter. | It is measured with a thermometer. |

### The relationship between heat and temperature
Temperature and heat are related but they are not the same thing. Temperature is a measure of the average kinetic energy of the particles in a substance, while heat is the transfer of energy from one object to another due to a temperature difference. In other words, temperature is a measure of how hot or cold something is, while heat is the energy that flows between objects to equalize their temperatures.

**Temperature:**
1. Measurement: Temperature can be measured using scales such as Celsius, Fahrenheit, or Kelvin.
2. Sensitivity: Temperature is sensitive to changes in heat energy.
3. Equilibrium: When two objects or systems are in thermal equilibrium, their temperatures are equal.
4. Expansion and Contraction: Most substances expand when heated and contract when cooled.

**Heat**:
1. Transfer: Heat is transferred from one object or system to another through conduction, convection, or radiation.
2. Energy: Heat is a form of energy that flows between objects or systems due to a temperature difference.
3. Direction: Heat always flows from a higher temperature object to a lower temperature object until thermal equilibrium is reached.
4. Measurement: Heat can be measured in units such as calories or joules.

## Thermometric liquid

*Thermometric liquid, also known as a thermometric fluid, is a substance used in a thermometer to indicate temperature changes.*

The choice of thermometric liquid depends on its ability to expand or contract uniformly over a specific temperature range, allowing for accurate temperature measurement.

Common thermometric liquids include:
1. Mercury: Historically, mercury was widely used in thermometers due to its uniform expansion over a wide temperature range. However, due to environmental and health concerns, the use of mercury in consumer products has been significantly reduced or eliminated in many countries.

2. Alcohol  Ethanol or other alcohol-based fluids are often used as alternatives to mercury in modern thermometers. Alcohol-based thermometric liquids are suitable for measuring a wide range of temperatures and are less hazardous than mercury.

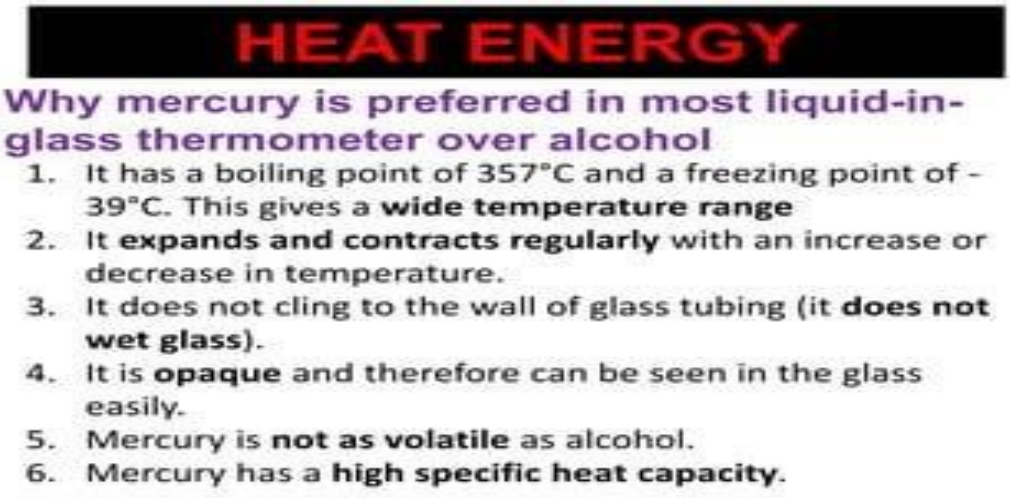
3. Galinstan: This is a non-toxic and environmentally friendly alternative to mercury, composed of gallium, indium, and tin. It has similar thermal properties to mercury and is used in some specialized thermometers.

**Qualities of a thermetric liquid.**

1. It does not cling to the wall of the glass tubing
2. it does not vapourize or condense
3. It should have a wide temperature range over which it exhibits consistent behavior

**Water is not used as a thermometric liquid in glass thermometers because:**

1. Water has a narrow temperature range over which it undergoes significant expansion, limiting its utility for measuring a wide range of temperatures accurately.
2. Water's freezing and boiling points are not suitable for many temperature measurement applications, especially those requiring extreme or high-temperature measurements.
3. Water's high surface tension can cause inaccuracies in temperature readings due to meniscus effects.
4. Water is prone to evaporation, which can lead to changes in the volume of the liquid inside the thermometer, affecting its calibration and accuracy.



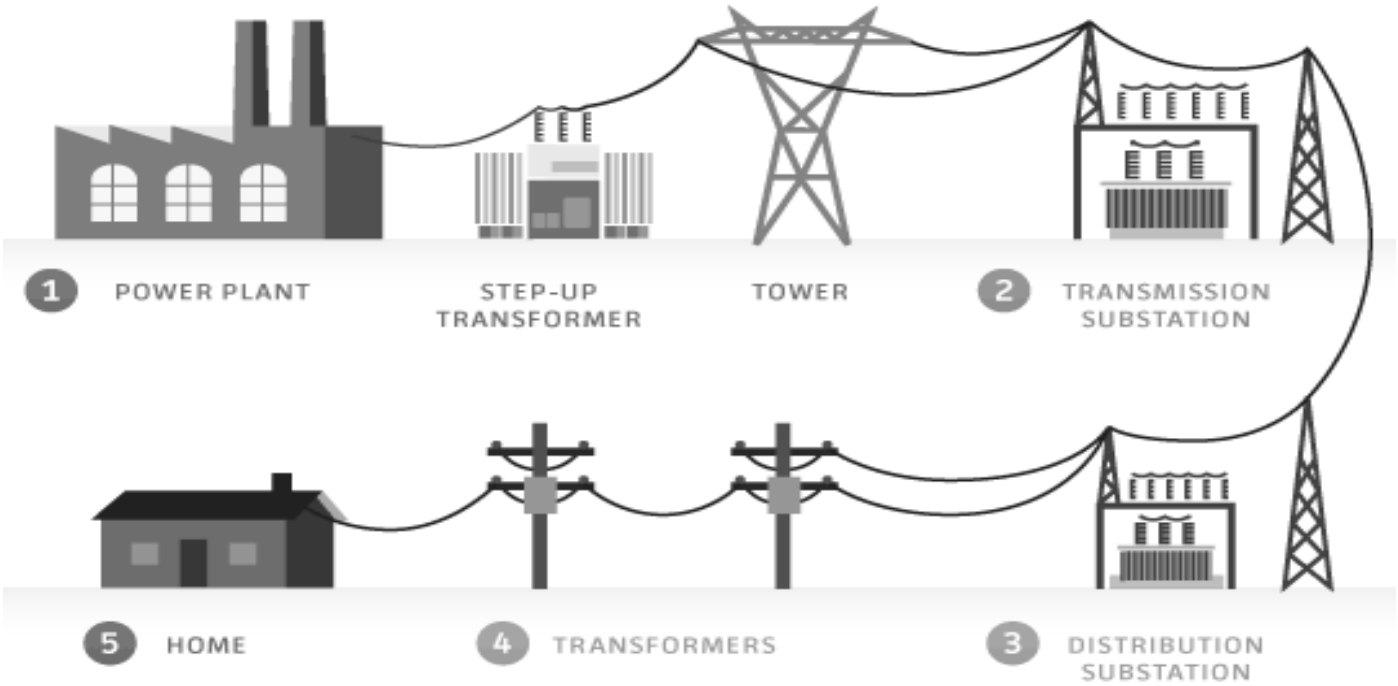
## STRAND 4 FORCES AND ENERGY
## SUB-STRAND 2 ELECTRICITY AND ELECTRONICS
### B8.4.2.1.1 Explain how electricity transmission occur

**Electricity transmission** *refers to the process of transporting electrical energy from power plants to consumers through a network of power lines and infrastructure .*

It involves the movement of electricity over long distances through a network of power lines, transformers, and substations. The electricity is generated at power plants, usually using various sources such as coal, natural gas, nuclear energy, or renewable sources like wind or solar. It is then stepped up to high voltages for efficient transmission and reduced losses. The high-voltage electricity is transmitted through transmission lines, which can be overhead lines or underground cables, to substations. At the substations, the voltage is stepped down to lower levels for distribution to homes, businesses, and other consumers. This allows us to access electricity for various purposes, such as powering our homes, running appliances, and operating industries. Electricity transmission is the process of transporting electrical energy from power plants to consumers through a network of power lines and infrastructure.

**The stages of transmission involve**

a. Generation
b. Transmission
c Distribution
d. Consumption




**Here are some key points to explain how electricity transmission works:**

**1. Power generation:** Electricity is generated at power plants, which can be located near energy sources such as coal, natural gas, nuclear, hydro, wind, or solar. The generated electricity is typically in the form of alternating current (AC).

**2. Step-up transformers:** Before transmission, the voltage of the electricity is increased using step-up transformers. This is done to minimize energy losses during long-distance transmission. Higher voltage allows for more efficient transmission over long distances.

**3. Transmission lines:** The electricity is then transmitted through a network of high-voltage transmission lines. These lines are designed to carry large amounts of electricity over long distances. They are often supported by tall towers or poles to ensure safe and reliable transmission.

**4. Substations:** Along the transmission lines, there are substations that help regulate and control the flow of electricity. Substations contain transformers that step down the voltage to a lower level for distribution to consumers.

**5. Distribution:** Once the electricity reaches a local area, it is further distributed to consumers through a network of lower-voltage distribution lines. These lines deliver electricity to homes, businesses, and other facilities.
**6. Transformers and meters:** At the consumer's location, distribution transformers step down the voltage to a level suitable for use. Electricity meters are installed to measure the amount of electricity consumed by each consumer for billing purposes.

## B8.4.2.2.1 Demonstrate the charging and discharging action of a capacitor in a dc electronic circuit

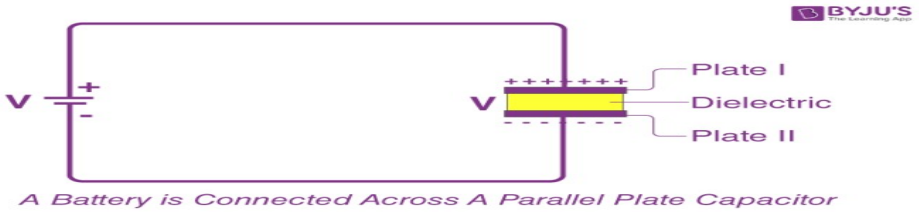
### What Is a Capacitor?

A capacitor is a two-terminal electrical device that can store energy in the form of an electric charge. It consists of two electrical conductors that are separated by a distance. The space between the conductors may be filled by vacuum or with an insulating material known as a dielectric. The ability of the capacitor to store charges is known as capacitance.

Capacitors store energy by holding apart pairs of opposite charges. The simplest design for a capacitor is a parallel plate, which consists of two metal plates with a gap between them. But, different types of capacitors are manufactured in many forms, styles, lengths, girths, and materials.

### How Does a Capacitor Work?

For demonstration, let us consider the most basic structure of a capacitor – the parallel plate capacitor. It consists of two parallel plates separated by a dielectric. When we connect a DC voltage source across the capacitor, one plate is connected to the positive end (plate I) and the other to the negative end (plate II). When the potential of the battery is applied across the capacitor, plate I become positive with respect to plate II. The current tries to flow through the capacitor at the steady-state condition from its positive plate to its negative plate. But it cannot flow due to the separation of the plates with an insulating material.



*A Battery is Connected Across A Parallel Plate Capacitor*

An electric field appears across the capacitor. The positive plate (plate I) accumulates positive charges from the battery, and the negative plate (plate II) accumulates negative charges from the battery. After a point, the capacitor holds the maximum amount of charge as per its capacitance with respect to this voltage. This time span is called the ***charging time of the capacitor***.
When the battery is removed from the capacitor, the two plates hold a negative and positive charge for a certain time. Thus, the capacitor acts as a source of electrical energy.

If these plates are connected to a load, the current flows to the load from Plate I to Plate II until all the charges are dissipated from both plates. This time span is known as the ***discharging time of the capacitor***.

**Capacitors** are electronic components that store and release electrical energy.
When connected in a direct current (DC) circuit, capacitors perform several functions:

1. Energy Storage: Capacitors store electrical energy in an electric field. When connected to a DC source, such as a battery, the capacitor charges up and stores energy in the form of an electric field between its two plates.

2. Voltage Stabilization: Capacitors help stabilize voltage levels in a DC circuit. They can smooth out fluctuations or ripples in the DC voltage by releasing stored energy when the voltage drops and absorbing excess energy when the voltage rises. This helps maintain a more constant voltage across the circuit.

3. Filtering: Capacitors can act as filters in DC circuits. They can block or attenuate certain frequencies of AC signals while allowing DC signals to pass through. This is useful for removing unwanted noise or interference from the DC circuit.

4. Timing and Delay: Capacitors can be used to create time delays or control the timing of events in a DC circuit. By charging and discharging at specific rates, capacitors can introduce delays or control the timing of signals in electronic circuits.

**Charging** is the process of adding electrical energy to a battery or a capacitor. This is typically done by connecting the battery or capacitor to a power source, such as a charger or a power outlet. During charging, the electrical energy is stored in the battery or capacitor for later use.

**Discharging** is the process of releasing the stored electrical energy from a battery or a capacitor. This is typically done by connecting the battery or capacitor to a device or a circuit that requires electrical power. During discharging, the stored energy is converted into electrical current and used to power the device or perform work.

**Demonstrate the charging and discharging action of a capacitor in a DC electronic circuit.**

In a DC electronic circuit, when a capacitor is connected to a DC voltage source, such as a battery, the capacitor starts to charge. Initially, the capacitor acts as an open circuit, blocking the flow of current. As time passes, the voltage across the capacitor gradually increases, and the current flowing into the capacitor decreases. Eventually, the capacitor becomes fully charged, and the current stops flowing.

When the DC voltage source is disconnected or a path is provided for the current to flow through, the capacitor starts to discharge. The stored energy in the capacitor is released, and the voltage across the capacitor decreases. The current flows from the negatively charged plate to the positively charged plate, creating a flow of current until the capacitor is fully discharged.

**Describe the charging and discharging action of a capacitor and explain the role of leds, diode, and resistor in an electronic circuit.**

When a capacitor is being charged, it is connected to a power source, such as a battery or a power supply.
The capacitor gradually *accumulates electrical energy as the voltage across its terminals increases.*
*This charging action occurs until the voltage across the capacitor reaches the same level as the power source.*
On the other hand, when a capacitor is being discharged, *it releases the stored electrical energy. This can happen when the capacitor is connected to a circuit or a device that requires electrical power. The capacitor discharges by releasing the stored energy in the form of an electrical current.*

**In an electronic circuit, LEDs, diodes, and resistors play different roles:**

1. LEDs (Light Emitting Diodes): leds are used to emit light when an electrical current passes through them. In a circuit, an LED can be connected in series with a resistor to limit the current flowing through it. When the circuit is powered, the LED lights up, indicating that the capacitor is discharging.

2. Diodes: Diodes are electronic components that allow current to flow in only one direction. In a circuit, a diode can be used to prevent the capacitor from discharging in the reverse direction. This ensures that the capacitor only discharges in the intended direction.

3. Resistors: Resistors are used to control the flow of electrical current in a circuit. In the context of charging and discharging a capacitor, a resistor can be used to limit the current flowing into or out of the capacitor. This helps to control the rate of charging or discharging and prevent excessive current flow, which could damage the components in the circuit.

## STRAND 4 FORCES AND ENERGY
## SUB - STRAND 3: CONVERSION AND CONSERVATION OF ENERGY
### B8.4.3.1.1. Explain the importance of conversion of energy and energy conservation in daily life

**Importance of conversion of energy and energy conservation in daily life:**
1. Sustainability: Energy conversion and conservation help in preserving natural resources and reducing the negative impact on the environment. By using renewable energy sources and minimizing energy waste, we contribute to a more sustainable future.

2. Cost savings: Energy conversion and conservation can lead to significant cost savings. By using energy-efficient appliances, insulating our homes, and practicing energy-saving habits, we can reduce our energy bills and save money in the long run.

3. Reduced carbon footprint: Energy conversion and conservation help in reducing greenhouse gas emissions. By using clean and renewable energy sources, such as solar or wind power, we can minimize our carbon footprint and contribute to mitigating climate change.

4. Energy security: By diversifying our energy sources and relying more on renewable energy, we can enhance energy security. Renewable energy is abundant and can be harnessed locally, reducing dependence on imported fossil fuels and volatile energy markets.

5. Health benefits: Energy conversion and conservation can have positive impacts on our health. By reducing air and water pollution associated with traditional energy sources, we can improve air quality and reduce the risk of respiratory and other health issues.

**The impact of energy conversion and conservation in the environment can be significant.**
Here are some findings:

**1. Reduced greenhouse gas emissions**: Energy conversion and conservation practices can help reduce the amount of greenhouse gases released into the atmosphere. By using renewable energy sources and improving energy efficiency, we can decrease our reliance on fossil fuels, which are major contributors to climate change.

**2. Preservation of natural resources:** Energy conservation helps in preserving natural resources such as coal, oil, and natural gas. By using energy more efficiently, we can reduce the need for extracting and burning these finite resources, which can have detrimental effects on ecosystems and habitats.

**3. Improved air quality:** Energy conversion to cleaner sources, such as solar or wind power, can help improve air quality by reducing the emissions of pollutants like sulfur dioxide, nitrogen oxides, and particulate matter. This can have positive impacts on human health and the environment.

**4. Conservation of water resources:** Energy production often requires significant amounts of water for cooling and other processes. By conserving energy, we can indirectly conserve water resources, as less energy demand means less water consumption for energy production.

**5. Mitigation of environmental degradation**: Energy conversion and conservation can help mitigate environmental degradation caused by activities like mining, drilling, and extraction of fossil fuels. By transitioning to cleaner energy sources and reducing energy consumption, we can minimize the negative impacts on ecosystems and biodiversity.

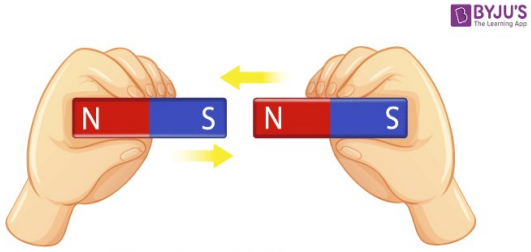
## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 4: FORCE AND MOTION

**B8.4.4.1.1. Demonstrate simple ways of making magnets and show how magnetic force can be applied in domestic industrial activities.**

### Magnetic field

**Magnetic field** is the region around a magnet where the magnetic force or influence is felt.

**A bar magnet**

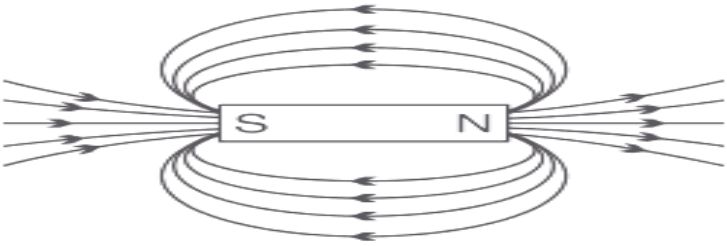



Properties of Bar Magnet

**Magnetic field lines/ Magnetic lines of force**

This refers to curved lines used to represent a magnetic field, drawn such that the number of lines relates to the magnetic field's strength at a given point and the tangent of any curve at a particular point is along the direction of magnetic force at that point.

**A bar magnet showing Magnetic lines of force or magnetic field lines**

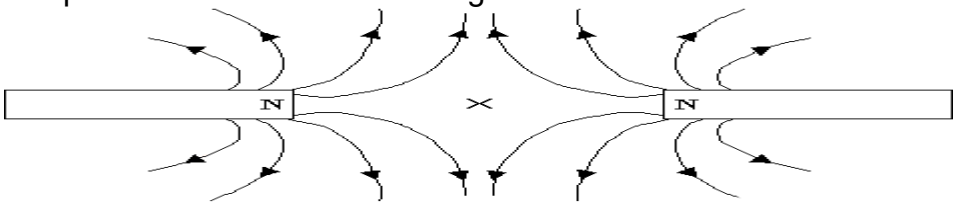



**Properties of magnetic lines of force**

- They are imaginary
- They always start and end on opposite poles.
- They indicate the direction of the magnetic force.
- They do not cross each other.

**Neutral point of magnetic field**

This is a point at which two magnetic forces are equal and opposite. **Or Neutral point of magnetic field** is a point where the resultant magnetic field is zero.




**Description of the use of a bar magnetic to differentiate between a magnetic material and a bar magnet**

- One end/pole of the magnet is brought close to one end of one of the test samples/bar magnet/magnetic material.
- The process is repeated using the same end of the magnet with opposite ends of the test samples.
- There is attraction between the magnet and the magnetic material when each end of the magnetic material is used.

- There is attraction between the magnet and the bar magnetic at one end and repulsion when the other end of the bar magnet is used
- Demagnetization is the process whereby a magnet loss its magnetic properties..

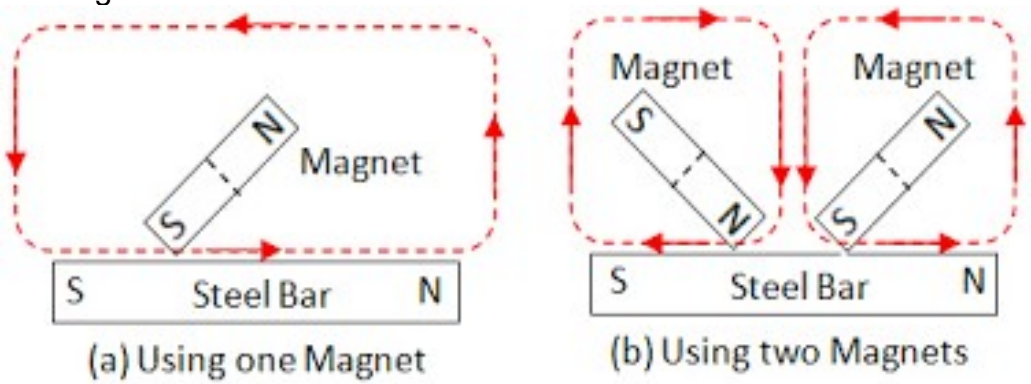
**Magnetization**

**Magnetization** is the process of producing a magnet from a magnetic material.

**Methods of magnetization in the laboratory**

**1. Stroking Method:**

The stroking method involves stroking a magnetic material along a piece of unmagnetized ferromagnetic material, such as iron or steel, in a consistent direction.
This repetitive stroking aligns the magnetic domains within the material, gradually inducing magnetism in the previously non-magnetic material. This method has two types single and double stroking



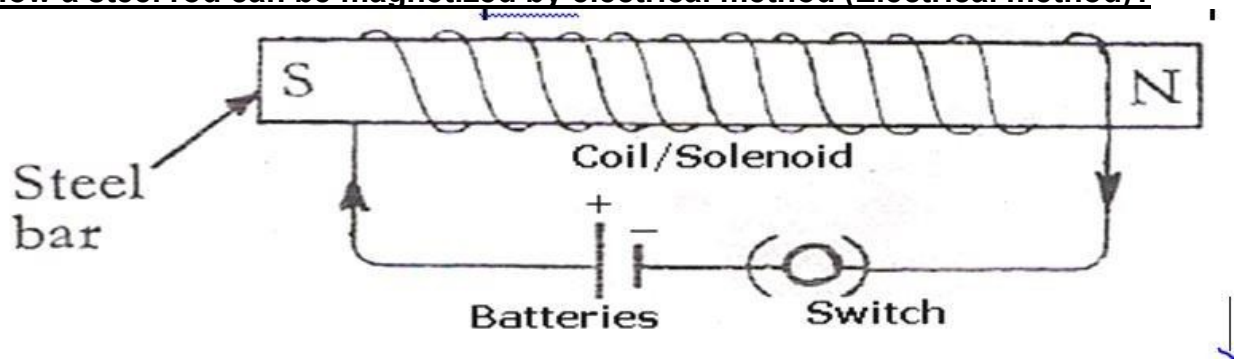

**2. Induction Method:**

- In the induction method, a ferromagnetic material is placed near a strong magnet, and the material is temporarily magnetized by the influence of the magnetic field.
- The strong magnetic field induces alignment of the magnetic domains within the material, causing it to exhibit temporary magnetism as long as it remains in close proximity to the magnet.

**3. Electrical Method (DC) or Electromagnetism:**

- The electrical method involves passing an electric current through a coil of wire wrapped around a ferromagnetic material, such as an iron core.
- When an electric current flows through the coil, it generates a magnetic field around the ferromagnetic core, effectively magnetizing the material.
- This electromagnetism principle is widely used in various devices, including electric motors, transformers, and magnetic cranes.

**How a steel rod can be magnetized by electrical method (Electrical method)?**



The rod is placed in a solenoid and the current is switched on and off. The rod will be found to be magnetized when withdrawn with the poles as indicated.

**Description of how a piece of nail or iron is magnetized using a bar magnet**

- The nail (iron) is stroked continuously in the same direction by the bar magnet.
- It is repeated several times, each time moving the magnet along the nail and far away in the direction indicated.

**Electromagnet**

**Electromagnet** is a magnet made by passing electric current through coils around a soft iron material.

**Factors that determines the strength of an electromagnet**

- Type of soft iron.
- Magnitude of current in the coil.
- Number of turns in the coil.

**Uses of electromagnet**

- It is used in electric bells
- In electric motors
- As magnetic separators.
- In car ignition systems.
- In telephone receivers/earpiece.
  - In loudspeakers and microphone

**Some examples of domestic and industrial activities where magnetic force plays a crucial role:**

**1. Compass:**

- A compass utilizes the magnetic force to align itself with the Earth's magnetic field, allowing users to determine the cardinal directions (north, south, east, and west). This simple yet essential device has been used for navigation for centuries, both at sea and on land.

**Using a compass to show direction is a straightforward process. Here's how you can use a traditional magnetic compass to determine direction**:

1. Hold the Compass Level:
   - Hold the compass flat in the palm of your hand, ensuring that it is level and stable. It's important to keep the compass away from any magnetic or ferrous objects that could interfere with its accuracy.

2. Find the Needle:
   - Observe the magnetic needle within the compass. The needle is usually marked with a distinct color (often red) to indicate one end. This end points to the Earth's magnetic north pole.

3. Align with North:
   - Rotate your body and the compass until the magnetic needle aligns with the "N" marking on the compass dial. This indicates that the marked end of the needle is pointing toward magnetic north.

4. Determine Direction:
   - Once the needle is aligned with "N," you can read off the directions for east, south, and west relative to your position based on where they fall on the compass dial.

**2. Alarms and Loudspeakers:**

- In alarm systems and loudspeakers, magnetic force is used in the form of electromagnets. When an electric current passes through the coil of wire in an electromagnet, it generates a magnetic field. This magnetic field interacts with a diaphragm or a metal armature, causing vibrations that produce sound in speakers or trigger alarms in security systems.

**3. Dynamo:**

- Dynamos, which are devices that convert mechanical energy into electrical energy, rely on the principles of electromagnetic induction. As a coil of wire rotates within a magnetic field, an electric current is induced in the wire due to the changing magnetic flux. This process is fundamental in generating electricity in various industrial and domestic applications, such as power generation in bicycles, hand-cranked flashlights, and early electrical generators.

## B8.4.4.1.1. Explain Newton's Second Law of motion and demonstrate its application to life

### Newton's Laws of motion Law

**1. Newton's First Law of Motion (Law of Inertia):** An object at rest will stay at rest, and an object in motion will stay in motion with the same speed and in the same direction unless acted upon by an external force.

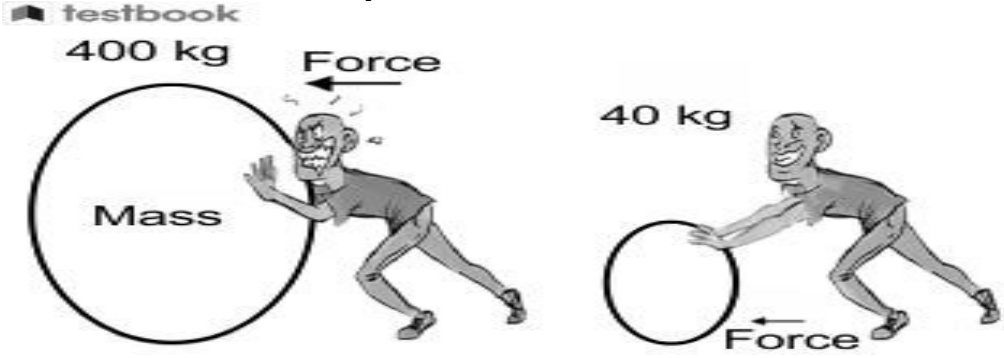
**2. Newton's Second Law of Motion (Law of Acceleration):** The acceleration of an object is directly proportional to the net force applied to it and inversely proportional to its mass. This can be mathematically represented as F = ma, where F is the net force, m is the mass of the object, and a is the acceleration.

**3. Newton's Third Law of Motion (Law of Action and Reaction):** For every action, there is an equal and opposite reaction. This means that whenever an object exerts a force on another object, the second object exerts an equal and opposite force on the first object.

### Newton's Second Law of Motion (Law of Acceleration):

*Newton's Second Law of motion states that the acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.*

This law can be applied to various aspects of life, such as understanding the relationship between force, mass, and acceleration in sports, transportation, and engineering.
For example, in sports, the force applied to a ball determines its acceleration and how far it will travel. In transportation, the mass of a vehicle affects how quickly it can accelerate or decelerate. In engineering, this law is used to design structures and machines that can withstand and distribute forces effectively.




### Everyday observations that illustrate Newton's second law of motion. Here are a few examples:

1. Pushing a shopping cart: When you push a shopping cart, the force you apply causes it to accelerate in the direction you're pushing. The heavier the cart, the more force you need to apply to achieve the same acceleration.

2. Throwing a ball: When you throw a ball, the force you exert on it determines how fast it accelerates and how far it travels. A stronger throw applies a greater force, resulting in a faster acceleration and a longer distance.
3. Riding a bicycle: When you pedal a bicycle, the force you apply to the pedals causes the bike to accelerate. The more force you apply, the faster you accelerate.

**An experiment that demonstrates the relationship between force and motion using a magnetic force and the principles of Newton's second law of motion.**

One experiment you can try is using a small magnet and a metal object, such as a paperclip. Start by placing the magnet on a flat surface, and then place the paperclip nearby.

When you release the paperclip, it will be attracted to the magnet and move towards it. The force of the magnet pulling on the paperclip is the force in this experiment.

To relate this to Newton's second law of motion, we need to consider the mass of the paperclip. If you use different paperclips with varying masses, you will notice that the heavier paperclips require more force to be pulled towards the magnet, while the lighter ones require less force.

This observation aligns with Newton's second law of motion, which states that the acceleration of an object is directly proportional to the net force applied to it and inversely proportional to its mass. In this experiment, the force applied by the magnet causes the paperclip to accelerate towards it.

So, in summary, this experiment demonstrates the relationship between force and motion using a magnetic force and the principles of Newton's second law of motion. The force exerted by the magnet causes the paperclip to accelerate towards it, and the mass of the paperclip affects the amount of force required for this motion.

### B8.4.4.2.1 Identify complex machines and describe their functions in life

## Recap what simple machines are from B7. 4.4.2.1

**A simple machine** is a mechanical device that helps to make work easier by changing the direction or magnitude of a force. It typically has few or no moving parts and operates on the principle of mechanical advantage. Some examples of simple machines include levers, pulleys, inclined planes, wedges, screws, and wheels and axles.
There are six **categories** of simple machines. These categories help us understand and classify different types of simple machines based on their characteristics and functions They are:

### Complex machines

**Complex machines** *are machines that are made up of multiple simple machines working together.*
Simple machines are basic mechanical devices that can change the direction or magnitude of a force. Examples of simple machines include levers, pulleys, inclined planes, wedges, screws, and wheels and axles.

Complex machines, on the other hand, are made up of combinations of these simple machines. They are designed to perform more complex tasks and often involve multiple moving parts. Complex machines can be found in various applications, such as automobiles, airplanes, industrial machinery, and even household appliances.

***The main difference between complex machines and simple machines is that complex machines involve the integration of multiple simple machines to achieve a specific function or task. Simple machines, on the other hand, are standalone devices that perform a specific mechanical function.***

**Examples of compound machines along with the simple machines they consist of:**

**1. Bicycle:** The bicycle is a compound machine that consists of several simple machines. It includes a wheel and axle (for the wheels), a lever (for the pedals), and a pulley system (for the chain and gears).

**2. Car:** A car is another compound machine that incorporates various simple machines. It includes wheels and axles (for the tires), a lever system (for the pedals and steering wheel), and an inclined plane (for the ramps and slopes).

**3. Tractor:** A tractor consists of several simple machines, including wheels and axles (for mobility), levers (for controlling the attachments and steering), and an inclined plane (for the ramps and slopes).

**4. Mist Blower:** A mist blower typically incorporates a fan, which is a type of wheel and axle. It may also include a pump, which utilizes an inclined plane to move fluids.

**5. Mower:** A mower utilizes a combination of simple machines. It includes wheels and axles (for mobility), levers (for controlling the cutting blades and height adjustment), and gears (for transferring power from the engine to the blades).

**6. Sewing Machine**: A sewing machine is a complex compound machine that consists of various simple machines. It includes wheels and axles (for the movement of the needle and fabric), levers (for controlling the thread tension and stitch length), and gears (for transferring power from the motor to the needle).

**Uses of machines**

1. Machines are used in manufacturing to automate production processes and increase efficiency.
2. In agriculture, machines such as tractors and harvesters are used to cultivate crops and gather produce.
3. Machines are employed in construction to lift heavy materials and assist in building structures.
4. Medical machines, like MRI scanners and X-ray machines, are used for diagnostic purposes in healthcare.
5. Machines are utilized in transportation, such as cars and airplanes, to enable faster and more convenient travel.
6. Computers and smartphones are examples of machines that are widely used for communication and information access.

**The functions of a complex machine can improve the quality of life in several ways:**

1. Efficiency: Complex machines are designed to perform tasks more efficiently than humans, which can save time and effort. For example, a washing machine can clean clothes faster and more effectively than hand washing, allowing people to spend their time on other activities.

2. Accuracy: Machines can perform tasks with a higher level of accuracy and precision than humans. This is particularly important in fields like medicine, where complex machines like surgical robots can perform delicate procedures with minimal error, leading to better outcomes for patients.

3. Safety: Complex machines can be designed to perform dangerous or hazardous tasks, reducing the risk to human operators. For instance, robots can be used in situations that are too dangerous for humans, such as exploring hazardous environments or defusing bombs.

4. Accessibility: Machines can make certain tasks more accessible to individuals with disabilities or physical limitations. For example, assistive technologies like wheelchairs or prosthetic limbs can greatly improve mobility and independence for people with mobility impairments.

5. Productivity: Complex machines can increase productivity by automating repetitive or labor-intensive tasks. This allows humans to focus on more complex and creative work, leading to higher productivity and innovation.

6. Convenience: Machines can provide convenience and simplify daily tasks. For example, household appliances like dishwashers and vacuum cleaners save time and effort, allowing people to spend more time on activities they enjoy.

## Test your mind

1. A _____ is a push or a pull.
A) simple machine B) pulley
C) force D) friction
2. Simple machines make work easier by trading _____ for force.
A) work B) distance
C) motion D) friction
3. A wheel barrow is an example of a _____ class lever.
A) second B) third
C) fourth D) first
4. Which is an example of a wheel and axle that make work easier by reducing friction?
A) ladder B) screwdriver
C) pencil sharpener D) wheelbarrow
5. Which part of the lever supplies the force to move something?
A) fulcrum B) load C) effort
6. Which part of the lever is the part you are trying to move?
A) load B) fulcrum C) effort
7. What should you do to reduce the amount of effort needed to lift something using a first class lever?
A) move the fulcrum to the middle of the lever
B) move the fulcrum closer to the load
C) move the fulcrum closer to the effort

1. What is the difference between a simple And a complex machine?
Answer : Simple Machine : Any of various Devices that function in a manner basic to Any machine, such as a lever, pulley, wedge, Screw, or inclined plane.
Complex Machine : A device consisting of two Or more simple machines working together.
2. Name the main types of simple machines.
Answer : Lever, Pulley, Wedge, Wheel and Axle, Screw, Inclined plane.
3. What is a wheel and axle arrangement?
Answer : A wheel and axle is a simple Machine consisting of a wheel attached to a Rod (axle).
4. Roads on hills are made to have very Gentle slopes. Why?
Answer : The roads on hills are gently Sloping in order to reduce the effect of Steepness which causes more downward Gravitational pull on the vehicle. A steeper Sloped road would slow the car down to a Greater extent that an gently sloping one.
5. List two ways in which a screw is more Useful than a nail.
Answer : (i) It takes less force to insert a Screw in wood than a nail. Therefore, a screw Increases force.
(ii) Also, because of the thread, it holds the Wood more firmly than a nail.
6. How does a screw jack work?
Answer : The screw jack that is used to lift a Car for changing wheel works on the principle Of a screw. When you turn the handle, the Screw of the jack turns around and lifts the Heavy car. The screw jack therefore increases
The force applied on the handle. However, the
Handle on which the force is applied, moves a
Much larger distance than the car.
7. Look around and find as many simple machines as you can. When you find a simple machine, write it down in the correct category the table below. If you find a compound machine (one that combines more than one simple machine), record it in the compound machine row. (Find at least three in each category).

**Simple Machine** **Examples**

**A. Lever** -Knife, Tweezers, Scissor
**B. Pulley**- Elevators, Cranes, Cargo lift system
**C. Inclined Plane** -Ladder, Sidewalk curb ramp, Slide
**D. Wheel and axle**- Screwdriver, Windmill, Pizza cutter
**E. Wedge** -Needle, Ice picks, Teeth
**F. Screw**- Bolt, Light bulb, Bottle caps
**G. Compound Machine**- Washing machine, Sewing machine, Grinder and mixer

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 5: AGRICULTURAL TOOLS

**B8.4.5.1.1Show and discuss the use of basic and simple agricultural tools for basic on-farm activities.**

**Farm tools** are instruments or equipment that are used in agriculture to perform various tasks. They are designed to make farming activities more efficient and easier. Some examples of farm tools include shovels, hoes, rakes, wheelbarrows, pitchforks, pruning shears, hand trowels, scythes, sprinklers, and milking machines. These tools are used for tasks such as digging, cultivating, planting, harvesting, and maintaining crops and animals on a farm


**Farm tools and their functions**

**1. Shovel:** Digging, lifting, and moving loose materials such as soil, gravel, or snow.

**2. Pickaxe**: Breaking up hard ground or rock, and removing roots.

**3. Spade:** Digging, edging, and moving soil and other materials.

**4. Hand trowel:** Planting, transplanting, and smoothing soil in small areas.

**5. Garden peg:** Securing garden fabric, netting, or other materials to the ground.

**6. Knapsack sprayer**: Applying pesticides, herbicides, or fertilizers to plants and crops.

**7. Hoe:** Loosening soil, weeding, and shaping soil in gardening and farming.

**9. Rake:** Gathering leaves, grass clippings, or other garden debris; leveling soil.

**10. Garden fork:** Turning and aerating soil, lifting and dividing plants.

**11. Garden shears:** Trimming and shaping bushes, hedges, and small branches.

**12. Wheelbarrow:** Transporting heavy or bulky materials such as soil, mulch, or plants.

**13. Sickle:** Harvesting grass or crops by hand.

**14. Secateurs:** Pruning and trimming small branches and stems in gardening.

**15. Head pan:** Carrying and transporting small amounts of materials on the head.

**17. Axe**: Chopping wood for fuel or construction purposes.

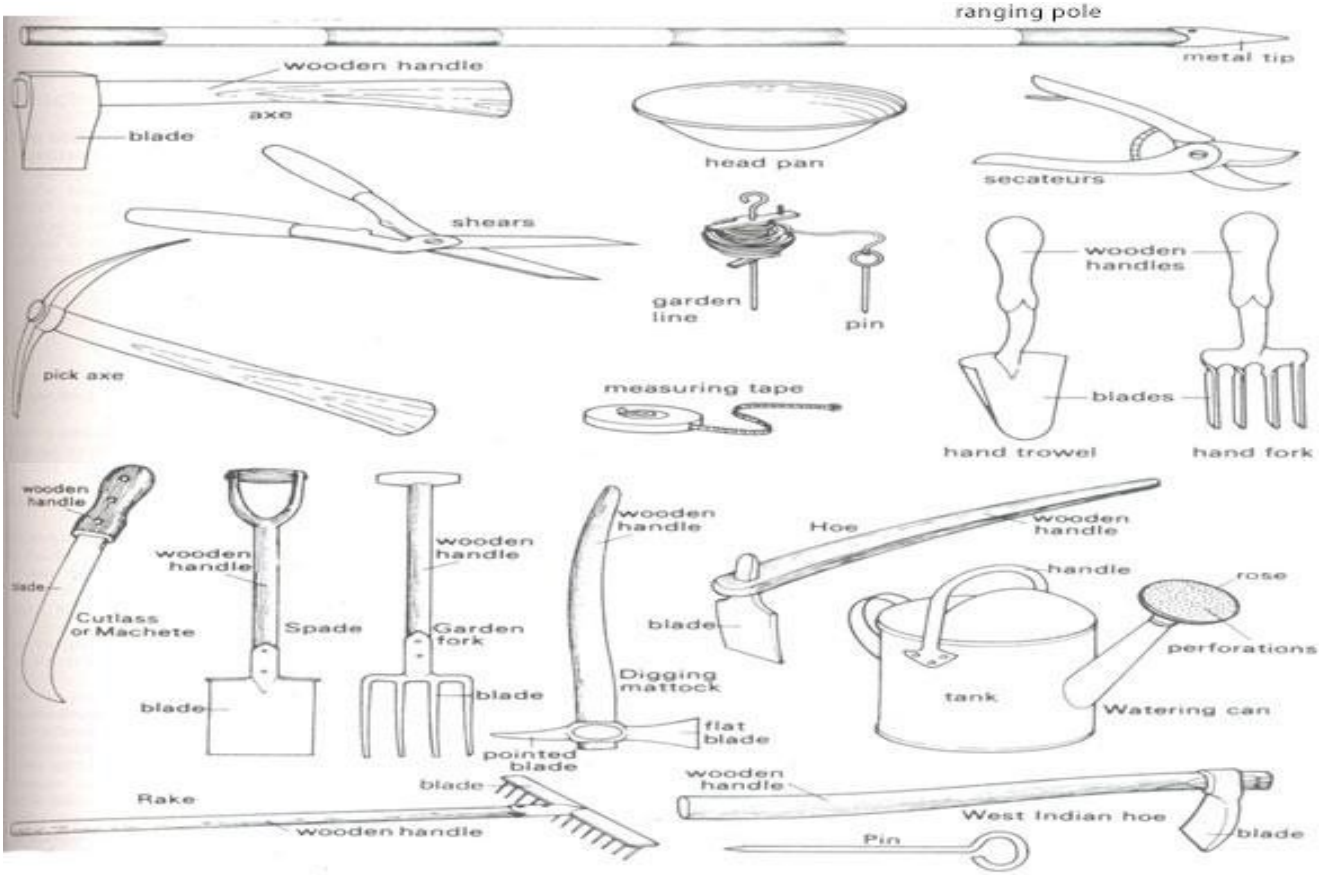
**18. Garden trowel:** Digging small holes for planting and transplanting in the garden.

**19. Mattock**: Breaking up hard ground or rock; digging in tough soil conditions.

**20. Cutlass:** Clearing undergrowth, cutting weeds, and light vegetation in the garden or field.

**21. Garden line**: Marking straight lines for planting seeds or setting boundaries in the garden.

**22. Dibber:** Creating holes in soil for planting seeds or small bulbs in the garden.




**The basic rules in handling and maintaining simple agricultural tools include:**

By following these basic rules, you can extend the lifespan of your agricultural tools and ensure they remain safe and effective for use on the farm.

1. Proper storage: Store tools in a clean and dry area to prevent rust and damage. Hang them on hooks or place them in a tool shed or toolbox.
2. Regular cleaning: After each use, clean the tools to remove dirt, debris, and any plant material. Use a brush or cloth to wipe them down and remove any moisture.
3. Sharpening and maintenance: Keep cutting tools, such as shovels, hoes, and pruning shears, sharp and in good condition. Regularly inspect the tools for any signs of wear or damage and repair or replace them as needed.

4. Lubrication: Apply lubricating oil or grease to moving parts, such as hinges or joints, to prevent rust and ensure smooth operation.
5. Proper handling: Use tools for their intended purpose and handle them with care. Avoid using excessive force or applying pressure in a way that could damage the tool or cause injury.
6. Safety precautions: Wear appropriate protective gear, such as gloves or safety glasses, when using tools. Follow safety guidelines and instructions provided by the manufacturer.
7. Regular maintenance: Periodically check and maintain the tools to ensure they are in good working condition. This may include tightening screws or bolts, replacing worn-out parts, or reapplying protective coatings.

**Indicator: B7.4.5.1.2 Maintenance of Agricultural tools.**

Agricultural tools need proper care and maintenance so that they can be used efficiently to perform the various farming operations for a longer period of time
**1. Cleaning**: Regularly clean your agricultural tools to remove dirt, debris, and any plant material that may have accumulated on them. This helps prevent rust and keeps the tools in good condition.
**2. Sharpening**: Sharpen the cutting edges of tools like knives, pruners, and shears to ensure clean and efficient cuts. Use a sharpening stone or file to maintain a sharp edge.
**3. Lubrication**: Apply lubricating oil or grease to moving parts of tools such as hinges, joints, and blades. This helps reduce friction and prevents rust.
**4. Rust prevention**: To prevent rust, store your tools in a dry place and consider using rust inhibitors or coatings. If you notice any signs of rust, remove it using a wire brush or sandpaper.
**5. Handle maintenance:** Inspect the handles of your tools regularly for any cracks or splinters. Sand down rough areas and apply a protective finish, such as linseed oil, to keep the handles in good condition.
**6. Storage:** Properly store your agricultural tools when not in use. Hang them on hooks or place them in a designated storage area to prevent damage and ensure easy access.

**Ways to maintain farm tools:**
1. Clean the tools after each use.
2. Store the tools in a dry and secure place.
3. Regularly inspect the tools for any signs of damage or wear.
4. Sharpen the cutting edges of the tools when necessary.
5. Lubricate the moving parts of the tools to prevent rust and ensure smooth operation.

**Reasons why maintaining farm tools is important:**
1. Extends the lifespan of the tools.
2. Ensures efficient and effective use of the tools.
3. Reduces the risk of accidents or injuries.
4. Saves money by avoiding frequent replacements.
5. Improves overall productivity on the farm.

**Precautions to be taken when manufacturing simple agricultural tools,**
1. Use safe materials that won't break easily.
2. Be careful and follow the rules to avoid getting hurt.
3. Measure everything correctly so the tools work well.
4. Test the tools to make sure they are good before giving them to others.
5. Make sure the tools are made the right way according to the rules.

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 1 WASTE MANAGEMENT
### B8.5.1.1.1 Explain sustainable waste management practices.

**Sustainable waste management practices** *involve strategies and methods aimed at minimizing the environmental impact of waste generation and disposal while promoting resource conservation and environmental protection.*
These practices include:
**1. Source Reduction:** Reducing the amount of waste generated at the source through measures such as product redesign, use of reusable products, and reduction of packaging.

**2. Recycling:** Collecting and processing materials such as paper, glass, plastic, and metal to produce new products, thus reducing the need for raw materials and energy.

**3. Composting:** Decomposing organic waste such as food scraps and yard trimmings to create nutrient-rich compost for soil enrichment, reducing the amount of organic waste sent to landfills.

**4. Waste-to-Energy:** Utilizing technologies to convert non-recyclable waste into energy through processes like incineration or anaerobic digestion, thus reducing reliance on fossil fuels.

**5. Landfill Diversion:** Implementing programs to divert waste from landfills through initiatives like donation, reuse, and repurposing of items.

**6. Extended Producer Responsibility (EPR):** Holding manufacturers responsible for the entire life cycle of their products, including collection, recycling, or safe disposal at the end of their useful life.

**7. Circular Economy Practices**: Embracing a circular approach where materials are reused, remanufactured, or recycled to minimize waste generation and resource depletion.

**8. Hazardous Waste Management**: Ensuring safe handling, treatment, and disposal of hazardous materials to prevent environmental contamination and protect public health.

### Scientific underlying methods used in waste management

The scientific underlying method used in waste management is known as the 3Rs: **Reduce, Reuse, and Recycle. *This method focuses on minimizing waste generation by reducing the amount of waste produced, reusing items whenever possible, and recycling materials to create new products***.
Additionally, waste management also involves proper disposal methods such as landfilling, incineration, and composting.
Some common methods include:

**1. Landfill:** This is the most common method of waste disposal, where waste is buried in designated areas called landfills. The waste is compacted and covered with soil to minimize odor and prevent contamination of groundwater. The method used in landfills is called "landfilling." It involves the disposal of waste materials by burying them in designated areas of land. The waste is compacted and covered with layers of soil to minimize odor, prevent the spread of diseases, and reduce the impact on the environment.

**Landfills play an important role in waste management and environmental protection**. Here are a few reasons why landfills are important:

- Landfills help keep our environment clean by providing a designated place for waste to be disposed of.
- Landfills prevent pollution by containing and isolating harmful materials from seeping into the soil and water sources.
- Landfills help control the spread of diseases by safely containing and managing waste that could attract pests and bacteria.
- Landfills conserve space by compacting waste, allowing us to use land more efficiently.
- Landfills can generate energy through the process of capturing and utilizing methane gas produced by decomposing waste.

**2. Incineration**: This method involves burning waste at high temperatures. Incineration can reduce the volume of waste and generate energy in the form of heat or electricity. However, it can also release pollutants into the air if not properly controlled. This method usually take place in furnace (heater or boiler).

**Importance of incineration used in waste management**

a) Incineration helps reduce the volume of waste by burning it, making more space available in landfills.
b) Incineration can generate electricity by using the heat produced from burning waste.
c) Incineration helps destroy harmful substances and pathogens that may be present in the waste.
d) Incineration can be a more environmentally friendly option compared to landfilling, as it reduces the release of greenhouse gases.
e) Incineration can help reduce the need for fossil fuels by using waste as a source of energy.

**3. Recycling**: Recycling involves the collection and processing of waste materials to create new products. This method helps conserve resources, reduce energy consumption, and minimize the amount of waste sent to landfills.

**The plastic recycling process steps**

**1. Collection:** Plastic waste is collected from various sources such as households, businesses, and recycling centers.
**2. Sorting:** The collected plastic waste is sorted based on its type and quality. This helps in separating different types of plastics for recycling.
**3. Shredding:** The sorted plastic waste is then shredded into small pieces to increase its surface area and facilitate further processing.
**4. Washing:** The shredded plastic pieces are thoroughly washed to remove any contaminants such as dirt, labels, or residue.
**5. Melting:** The cleaned plastic pieces are melted down to form a molten plastic material.
**6. Extrusion or Molding:** The molten plastic is then either extruded through a die to form plastic pellets or molded into specific shapes using molds.
**7. Manufacturing:** The plastic pellets or molded shapes are used as raw materials in the manufacturing of new plastic products.

**Processes involved in recycling of paper**

**1. Collection :** Paper waste is collected from various sources such as households, offices, and recycling centers...
**2. Sorting**: The collected paper is sorted based on its type, quality, and color. This helps in ensuring that only suitable paper is used for recycling.

**3. Shredding:** The sorted paper is then shredded into small pieces to increase its surface area and make it easier to process.
**4. Pulping**: The shredded paper is mixed with water and chemicals to create a pulp. The chemicals help break down the paper fibers and remove any ink or contaminants.
**5. Cleaning:** The pulp is cleaned to remove any remaining impurities, such as staples or plastic.
**6. Deinking:** In this step, the pulp is treated with chemicals and mechanical processes to remove ink and other coatings from the paper fibers.
**7. Refining**: The cleaned and deinked pulp is refined to improve its quality and strength.
**8. Forming:** The refined pulp is then formed into new paper sheets using various techniques, such as pressing and drying.
**9. Finishing:** The newly formed paper sheets may undergo additional processes, such as coating or calendaring, to enhance their properties.
**10. Distribution**: The recycled paper is then packaged and distributed to be used in various applications, such as printing, packaging, or manufacturing.

**Important reasons why recycling is significant:**

a. Recycling helps save natural resources by turning old materials into new ones.
b. Recycling reduces the amount of waste that goes to landfills, helping to protect the environment.
c. Recycling saves energy because it takes less energy to make products from recycled materials compared to using raw materials.
d. Recycling helps reduce pollution by reducing the need for extracting, refining, and processing raw materials.
e. Recycling creates jobs in industries that collect, process, and manufacture recycled materials.

**4. Composting**: Composting is the process of decomposing organic waste, such as food scraps and yard waste, into nutrient-rich soil. This method is environmentally friendly and can be used for agricultural purposes.

**Compost** is a type of organic matter that is created through the decomposition of various organic materials, such as food scraps, yard waste, and other biodegradable materials. It is a natural process where microorganisms break down the organic matter, resulting in a nutrient-rich soil amendment. Compost is commonly used in gardening and agriculture to improve soil quality, retain moisture, and provide essential nutrients for plants. It is an environmentally friendly way to recycle organic waste and reduce the need for chemical fertilizers.

**Starters.** Are materials that help kickstart the decomposition process in a compost pile. *They provide the necessary nutrients and microorganisms that break down organic matter into nutrient-rich compost.* Some common starters include fruit and vegetable scraps, coffee grounds, tea bags, and crushed eggshells.

**Methods of composting**

I. **Pit method**

Pit composting is a method of composting where organic materials are placed in a pit or hole in the ground. This method involves digging a pit or trench, usually about 1-2 feet deep, and filling it with a mixture of organic waste, such as food scraps, yard waste, and other biodegradable materials. The pit is then covered with soil or a layer of straw to help retain moisture and promote decomposition

**Ii. Stack or Heap methods**

The heap method of composting involves creating a large pile or heap of compost materials. This method requires less maintenance and turning compared to the stack method. It is commonly used for smaller-scale composting or home composting.

**Organic materials that can be added to the compost**

1. Cut grass
2. Leaves
3. Maize stover
4. Lawn chippings
5. Animal manure

**Principles involved in composting**

1. Site selection
2. Gathering of compost materials
3. Waste management
4. Aeration the compost
5. Monitoring the compost
6. Include starters

**Importance of composting**

1. Reduces waste
2. Decreases greenhouse gas emissions
3. Improves soil fertility
4. Retains moisture in the soil
5. Suppresses pests and weeds

**5. Waste-to-Energy**: This method involves converting waste into energy through various processes, such as anaerobic digestion or gasification. It helps reduce the reliance on fossil fuels and can generate electricity or heat.

**Importance of managing waste**

1. Protecting the environment from pollution and degradation.

2. Conserving natural resources and energy.

3. Minimizing health risks for communities and ecosystems.

4. Reducing greenhouse gas emissions and mitigating climate change.

5. Promoting sustainable and responsible consumption and production practices.

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 2: HUMAN HEALTH
### B8. 5.2.1.1 Explain the symptoms, effects and prevention of common communicable diseases.

**Diseases** is any disorder which interferes negatively with the normal functioning of the body of an organism.

**Health** is the complete physical, mental, and social-wellbeing of a person and not merely the absence of diseases and infirmities.

**Symptoms** are abnormal changes or signs in the body of a person which helps the doctor to identify a disease.

**Vector** is an agent which transmit a disease-causing organism to a person.

**Two main types and causes of diseases**

1. Pathogens or pathogenic diseases
2. Non- pathogenic diseases or nutritional or metabolic disorders.

**Pathogens/ pathogenic diseases**

This is a disease-causing agent or microbes or micro-organism.

**Ways in which pathogens (micro-organism) are transmitted from person to person or human body**

- Through (contaminated) food or drink.
- Through air by droplet infection.
- Through a vector.
- By direct contact with an infected person.
- Sharing infected materials or items.
- Through wounds/ cuts/ opening on the body.
-

**Ways in which the human body defends itself from disease causing organisms**

- The skin prevent disease causing organisms from entering.
- The white blood cells engulf germs that invade the body.
- The body produces antibodies which destroy the effect of the toxins produced by pathogens.
- Hydrochloric acid in the stomach kills bacteria in the food.
- Cilia and mucus in the nasal passage trap dust particles which contain pathogens.

**Diseases can be group into two main types**

A. Infectious diseases
B. Non-infectious disease

**Infectious diseases**

**Infectious diseases**. These are diseases caused that are caused by micro-organisms. Example, viral, protozoan, fungi, bacterial and worm diseases.

**Types of Infectious diseases**

**A. Communicable** These are diseases which are can easily be transmitted from one organism to another through air. Eg common cold, TB, etc.

**B. Contagious diseases.** These are diseases transmitted through contact with an infected organism. Most viral diseases are contagious. Example, swine fever, influenza, cold etc.

**Terms associated with Pathogenic diseases**

- **Zoonotic diseases**. These are diseases that affect both humans and livestock (animals). Examples, rabies, anthrax and bird flu.

- **Epizootic diseases.** These are diseases that are prevalent only temporarily. Examples, red water and Heartwater.
- **Endemic diseases.** These are diseases that become prevalent in a particular community, area or geographical region on regular basis. Examples, trypanosomiasis and buruli ulcer.
- **A pandemic** is an epidemic that's spread over multiple countries or continents.
- **An epidemic** is a disease that affects a large number of people within a community, population or region.

**Types of Pathogen/ pathogenic diseases**

1. Bacteria
2. Viruses
3. Fungi
4. Protozoa
5. Worms
6. Rickettsia

**Types of Pathogen/ pathogenic diseases**

1. **Bacteria:**
   - Bacteria are single-celled microorganisms that can cause disease by producing toxins or damaging host tissues. Some bacteria invade the body's tissues directly, while others release toxins that can lead to symptoms of illness. Bacterial infections can affect various parts of the body, leading to conditions such as pneumonia, urinary tract infections, and food poisoning.

2. **Viruses:**
   - Viruses are tiny infectious agents that can only replicate inside the cells of living organisms. They invade host cells and use their cellular machinery to reproduce, often causing damage to the host cell in the process. Viral infections can result in a wide range of diseases, including the common cold, flu, HIV/AIDS, and COVID-19.

3. **Fungi:**
   - Fungi are a group of organisms that include yeasts, molds, and mushrooms. Fungal pathogens can cause disease by invading tissues or by producing toxic substances. Fungal infections can affect the skin, nails, respiratory system, and other parts of the body, leading to conditions such as athlete's foot, ringworm, and invasive fungal diseases in immunocompromised individuals.

4. **Protozoa**:
   - Protozoa are single-celled eukaryotic organisms that can cause diseases such as malaria, amoebiasis, and giardiasis. They often infect the digestive tract or other body systems, leading to symptoms such as diarrhea, abdominal pain, and fever. Protozoan parasites can be transmitted through contaminated water or food, insect vectors, or direct contact with infected individuals.

5. **Worms:**
   - Worms, also known as helminths, are parasitic organisms that can infect humans and cause a variety of diseases. These include conditions such as schistosomiasis, ascariasis, and tapeworm infections. Worms can enter the body through contaminated food or water, penetrate the skin, or be transmitted by insect vectors.

6. **Rickettsia**:
   - Rickettsia are a group of bacteria that are often transmitted to humans through arthropod vectors such as ticks, fleas, and lice. They can cause diseases like Rocky Mountain spotted fever and typhus fever by invading endothelial cells (cells lining blood vessels) and triggering an inflammatory response in the host.

**Communicable diseases**, also known as infectious diseases, are illnesses that can be spread from one person to another or from animals to humans. These diseases are caused by microorganisms such as bacteria, viruses, fungi, or parasites.
Examples of communicable diseases include the common cold, influenza, tuberculosis, HIV/AIDS, and COVID-19

## A. Hepatitis

**Hepatitis** is a group of viral infections that affect the liver. There are several types of hepatitis, including hepatitis A, B, C, D, and E. Here is some information about the causes, symptoms, and prevention of hepatitis:

### *1. Causes:*

**- Hepatitis A:** It is caused by the hepatitis A virus (HAV) and is usually spread through *contaminated food or water, or close contact with an infected person.*

**- Hepatitis B**: It is caused by the hepatitis B virus (HBV) and is transmitted through contact with *infected blood, semen, or other body fluids.*

**- Hepatitis C:** It is caused by the hepatitis C virus (HCV) and is primarily transmitted through *contact with infected blood. It can also be transmitted through sexual contact or from an infected mother to her baby during childbirth.*

**- Hepatitis D:** It is caused by the hepatitis D virus (HDV) and only occurs in individuals who are already *infected with hepatitis B.*

**- Hepatitis E:** It is caused by the hepatitis E virus (HEV) and is usually transmitted through contaminated *water or food.*

### *2. Symptoms:*

- Hepatitis A: Symptoms may include ***fatigue, nausea, vomiting, abdominal pain, dark urine, clay-colored stools, and jaundice (yellowing of the skin and eyes).***

- Hepatitis B, C, D, and E: Symptoms may include ***fatigue, loss of appetite, nausea, vomiting, abdominal pain, dark urine, clay-colored stools, joint pain, and jaundice***.

### Effects of Hepatitis:

**1. Liver inflammation**: Hepatitis can cause inflammation of the liver, leading to symptoms such as fatigue, jaundice (yellowing of the skin and eyes), and abdominal pain.

**2. Liver damage**: Prolonged or severe cases of Hepatitis can result in liver damage, which can lead to complications like liver cirrhosis or liver failure.

**3. Impaired liver function:** Hepatitis can affect the liver's ability to perform its normal functions, such as detoxifying the body, producing bile, and metabolizing nutrients and medications.

**4. Increased risk of liver cancer:** Certain types of Hepatitis, such as Hepatitis B and C, can increase the risk of developing liver cancer over time if left untreated.

### *3. Prevention:*

**- Hepatitis A:**

- Practicing good hygiene, such as washing hands thoroughly, consuming clean water,.
- Getting vaccinated can help prevent hepatitis A.

**- Hepatitis B:**

- Getting vaccinated,
- Practicing safe sex,
- Avoiding sharing needles or other drug paraphernalia, and using sterile equipment for tattoos or body piercings can help prevent hepatitis B.

**- Hepatitis C:**

- Avoiding sharing needles or other drug paraphernalia,
- Practicing safe sex, and
- Using precautions to prevent contact with infected blood can help prevent hepatitis C.

**- Hepatitis D:**
Hepatitis D can only occur in individuals who are already infected with hepatitis B. Preventing hepatitis B infection through vaccination and other preventive measures can indirectly prevent hepatitis D.

**- Hepatitis E:**
Practicing good hygiene, such as washing hands thoroughly and consuming clean water, can help prevent hepatitis E.

### *B. HIV*

**HIV** stands for ***Human Immunodeficiency Virus.*** It is a virus that attacks the immune system, specifically the CD4 cells (T cells), which are crucial for fighting off infections and diseases. HIV can lead to acquired immunodeficiency syndrome (AIDS), a condition in which the immune system is severely damaged, making individuals more susceptible to infections and certain cancers.

***Causes of HIV:***
HIV, which stands for Human Immunodeficiency Virus, is primarily transmitted through certain body fluids, *including blood, semen, vaginal fluids, and breast milk*. The most common modes of transmission are *unprotected sexual intercourse, sharing needles or syringes, and from mother to child during childbirth or breastfeeding.*

***Symptoms of HIV:***
The symptoms of HIV can vary from person to person and may not appear immediately after infection. Some common symptoms include
1.Fever 2. Fatigue, 3. Swollen lymph nodes, 4.sore throat, 5. Rash,

6. Muscle and joint pain, 7. Headache.

However, it's important to note that these symptoms can also be caused by other illnesses, and some people with HIV may not experience any symptoms at all.

**Effects of HIV:**
1. Weakened immune system: HIV attacks the immune system, specifically CD4 cells, which are crucial for fighting off infections and diseases. As a result, the immune system becomes weakened, making individuals more susceptible to various infections and illnesses.

2. Opportunistic infections: With a weakened immune system, people living with HIV are at a higher risk of developing opportunistic infections, such as pneumonia, tuberculosis, and certain types of cancers.

3. HIV/AIDS-related complications: Over time, HIV can progress to AIDS (Acquired Immunodeficiency Syndrome), which is the most advanced stage of HIV infection. AIDS is characterized by severe immune system damage and can lead to a range of complications, including neurological disorders, wasting syndrome, and organ failure.

4. Impact on overall health: HIV can have a significant impact on an individual's overall health and well-being. It can cause symptoms such as fatigue, weight loss, fever, and night sweats. Additionally, HIV can affect various organs and systems in the body, including the cardiovascular, respiratory, and gastrointestinal systems.

5. Social and psychological impact: Living with HIV can also have social and psychological effects. Stigma and discrimination surrounding HIV can lead to isolation, mental health issues, and difficulties in relationships and employment.

***Prevention of HIV:***
Prevention is crucial in reducing the spread of HIV. Here are some preventive measures:
1. Practice safe sex: Use condoms consistently and correctly during sexual intercourse, especially with new or multiple partners.

2. Avoid sharing needles: If you use drugs, avoid sharing needles or other drug paraphernalia. Use sterile equipment and seek help for substance abuse if needed.
3. Get tested and know your partner's status: Regularly get tested for HIV and encourage your partner to do the same. Knowing your status and that of your partner can help make informed decisions about sexual activity.
4. Consider pre-exposure prophylaxis (prep): prep is a medication that can be taken by individuals at high risk of HIV to prevent infection. Consult a healthcare professional to see if prep is suitable for you.
5. Prevent mother-to-child transmission: Pregnant women with HIV can take antiretroviral therapy to reduce the risk of transmitting the virus to their babies. It's important to seek prenatal care and follow medical advice.

## ***C. Measles***

***Measles*** is a highly contagious viral infection that primarily affects the respiratory system. It is caused by the measles virus and is characterized by symptoms such as high fever, cough, runny nose, red and watery eyes, and a rash that starts on the face and spreads to the rest of the body. Measles can be a serious illness and can lead to complications such as ear infections, pneumonia, and in severe cases, brain inflammation.
Causes of measles:

Measles is caused by a highly contagious virus called the ***measles virus***. It spreads through respiratory droplets when an infected person coughs or sneezes. The virus can survive in the air or on surfaces for up to two hours, making it easy to contract.

**Symptoms of measles:**
The symptoms of measles typically appear about 10-14 days after exposure to the virus. They include high ***fever, cough, runny nose, red and watery eyes, and a rash*** that starts on the face and spreads to the rest of the body. Measles can also cause complications such as ear infections, pneumonia, and in severe cases, brain inflammation.

**Effects of measles:**
1. Fever: Measles typically causes a high fever, which can last for several days.
2. Rash: One of the most recognizable symptoms of measles is a red, blotchy rash that usually starts on the face and then spreads to the rest of the body.
3. Cough and runny nose: Measles can also cause a persistent cough and a runny nose, similar to symptoms of a common cold.
4. Conjunctivitis: Measles may lead to inflammation and redness of the eyes, known as conjunctivitis or pink eye.
5. Complications: In some cases, measles can lead to more severe complications, such as pneumonia, ear infections, and in rare cases, brain inflammation (encephalitis).

**Prevention of measles:**
The most effective way to prevent measles is through **vaccination.** The measles vaccine is usually given as part of the measles-mumps-rubella (MMR) vaccine. It is recommended that children receive two doses of the MMR vaccine, with the first dose given at 12-15 months of age and the second dose at 4-6 years of age. Adults who have not been vaccinated or are unsure of their vaccination status can also get vaccinated.

Additionally, practicing good hygiene, such as washing hands frequently with soap and water, covering the mouth and nose when coughing or sneezing, and avoiding close contact with infected individuals, can help prevent the spread of measles.

## ***B8. 5.2.1.2. Analyze the risk factors of communicable diseases***

***Risk* factors of communicable diseases**, *risk factors are factors that increase the likelihood of contracting or spreading a communicable disease.*

These factors can include things like lack of vaccination, poor hygiene practices, close contact with infected individuals, traveling to areas with high disease prevalence, weakened immune system, poor sanitation and living conditions, and lack of access to healthcare.

**Some common risk factors for many diseases include:**

1. Lack of vaccination: Not being vaccinated or not following the recommended vaccination schedule can increase the risk of contracting certain communicable diseases.

2. Poor hygiene practices: Not practicing good hygiene, such as not washing hands regularly or not covering the mouth and nose when coughing or sneezing, can increase the spread of communicable diseases.

3. Close contact with infected individuals: Being in close proximity to someone who is infected with a communicable disease can increase the risk of contracting the disease.

4. Traveling to areas with high disease prevalence: Traveling to regions or countries with a high prevalence of certain communicable diseases can increase the risk of exposure and infection.

5. Weakened immune system: Having a weakened immune system due to certain medical conditions, such as HIV/AIDS or undergoing immunosuppressive treatments, can make individuals more susceptible to communicable diseases.

6. Poor sanitation and living conditions: Living in overcrowded or unsanitary conditions can increase the risk of communicable diseases, as it facilitates the spread of pathogens.

7. Lack of access to healthcare: Limited access to healthcare services, including preventive measures and treatment, can increase the risk of communicable diseases.

**B8.5.2.2.1. Explain the nature of bacterial diseases with emphasis on food poisoning, gonorrheoea and meningitis their causes, symptoms, effects on humans and preventions**.

Bacterial diseases are caused by harmful bacteria that invade the body and disrupt its normal functioning.
Bacterial diseases are caused by harmful bacteria that invade the body and multiply, leading to various symptoms and effects on humans. Bacteria are single-celled microorganisms that can multiply rapidly and produce toxins that harm the body's tissues. These diseases can affect various parts of the body, such as the respiratory system, digestive system, urinary tract, and skin.

Some common examples of bacterial diseases include pneumonia, tuberculosis, urinary tract infections, and food poisoning. Here is an explanation of the nature of three bacterial diseases: food poisoning, gonorrhea, and meningitis, including their causes, symptoms, effects on humans, and preventions.

**1. Food Poisoning:**

**- Causes:** Food poisoning is caused by consuming food or drinks contaminated with harmful bacteria, such as Salmonella, E. Coli, or Campylobacter.

**- Symptoms:** Common symptoms include nausea, vomiting, diarrhea, abdominal pain, and sometimes fever.

**- Effects on Humans:** Food poisoning can lead to dehydration, electrolyte imbalances, and in severe cases, it can cause organ damage or even be life-threatening.

**- Prevention:** To prevent food poisoning, it is important to practice good food hygiene, such as washing hands before handling food, cooking food thoroughly, storing food at the correct temperature, and avoiding cross-contamination.

**2. Gonorrhea:**
**- Causes**: Gonorrhea is a sexually transmitted infection caused by the bacterium Neisseria gonorrhoeae.
**- Symptoms**: Symptoms of gonorrhea may include painful urination, abnormal discharge from the genitals, and in some cases, no symptoms at all.

**- Effects on Humans**: If left untreated, gonorrhea can lead to serious complications, such as pelvic inflammatory disease (in women), infertility, and an increased risk of contracting or transmitting HIV.

**- Prevention:** The best way to prevent gonorrhea is to practice safe sex by using condoms consistently and getting regular sexual health check-ups. Early detection and treatment are crucial.

***3. Meningitis:***
**- Causes**: Meningitis can be caused by various bacteria, including Streptococcus pneumoniae, Neisseria meningitidis, and Haemophilus influenzae.

**- Symptoms:** Symptoms of meningitis may include severe headache, fever, stiff neck, sensitivity to light, nausea, and vomiting. In infants, symptoms may also include irritability, poor feeding, and a bulging fontanelle (soft spot on the head).

**- Effects on Humans**: Meningitis can be a life-threatening condition, leading to brain damage, hearing loss, learning disabilities, and in severe cases, death.

**- Prevention:** Vaccination is an effective way to prevent certain types of bacterial meningitis. Maintaining good hygiene, such as washing hands regularly and avoiding close contact with infected individuals, can also help reduce

**Diseases caused by Bacteria (Causative agent)**

| **Diseases** | **Symptoms** | **Mode of transmission** | **Prevention/ control** |
|---|---|---|---|
| **Typhoid fever (Salmonella typhi)** | Fever, diarrhoea, pain in stomach | Contaminated water or food | - Clean water supply<br>- Safe disposal of sewage<br>- Hygienic preparation of food. |
| **Whooping cough (Bordetella pertussis)** | Severe cough, vomiting. | Airborne, droplet infection | - Mass immunization with DPT vaccine<br>- Cover your mouth when sneezing. |

| | | | |
|---|---|---|---|
| **Tetanus (Clostridium tetani)** | Muscular spasm in the mouth and neck regions. | Through cuts of wounds in skin. | - Keep cuts and wounds covered until healed<br>- Anti-tetanus vaccination as soon as one gets a cut or wound. |
| **Cerebrospinal Meningitis – CSM** | High fever, headache, stiff neck, photophobia, convulsion, coma. | Airborne or droplet infection | - Avoid overcrowding places<br>- Uses of drugs<br>- Isolating infected person |
| **Tuberculosis – TB (Mycobacterium tuberculosis)** | Weight loss, cough, fever, chest pain. | Airborne or through infected cattle milk. | - Vaccination with BCG vaccine<br>- Isolating infected person |
| **Cholera (Vibrio cholerae)** | Bacteria release powerful toxin causing inflammation of the gut and severe diarrhoea (rice water). The resulting loss of water and mineral salts may lead to death. | Waterborne and foodborne. | - Purification of water and treatment of sewage.<br>- Vaccination 3-12 months. |
| Anthrax (Bacillus anthracis) | High fever, swelling in the neck. | Contaminated water and pasture. | - All the entire vicinity should be disinfected. |

## STRAND 5 HUMANS AND THE ENVIRONMENT
## SUB-STRAND 3 SCIENCE AND INDUSTRY

**B8. 5.3.1.1 Examine the relationship among science, technology, innovation and society**
**Science, technology, and innovation are interconnected and mutually dependent. They rely on each other to advance and drive progress in various fields, leading to societal development and improvement. The interrelationship of science, technology, and innovation is closely intertwined.**

**A. Science** provides the foundation for technological advancements and innovation. It involves the systematic study and understanding of the natural world, which leads to the discovery of new knowledge and principles.

**B. Technology**, on the other hand, refers to the practical application of scientific knowledge for practical purposes. It involves the development and use of tools, machines, materials, and processes to solve problems, improve efficiency, and meet human needs.

**C. Innovation** is the process of developing new ideas, products, or methods that bring about positive change. It often involves combining scientific knowledge and technological advancements to create something new or improve existing system.

D. Science drives technological advancements by providing the knowledge and understanding necessary for the development of new technologies.

E. Technological advancements, in turn, can lead to new scientific discoveries by enabling researchers to observe and measure phenomena that were previously in accessible. Innovation acts as a catalyst for the interplay between science and technology. It takes scientific knowledge and technological advancements and applies them in new and creative ways to address societal needs and challenges.

**Difference between Science & Technology**

| Science | Technology |
|---|---|
| Primarily deals with the study and discovery of laws and theories which are not tangible. | It deals with the production of tangible items such as computers, automobiles, industrial machines etc. |
| Changes occur gradually | Changes occur in relatively shorter time |
| Scientific facts or principles can be demonstrated easily | Technological principles cannot be demonstrated easily. |
| Involves investigating into nature. | Involves putting scientific knowledge to practical use. |

**Significance or Importance of Science and Technology to the development of Society**

- ✓ It has improved Health. The application of technology has led to the production of vaccines and drugs to fight against diseases such as small pox, measles, tetanus etc.
- ✓ Improved Communication. Technology has made accessing, processing and transmission of information easier and faster. Computer, fax machines, mobile phones etc. Have been produced to enhance communication in the world.
- ✓ Improved Agriculture. The provision of mechanized farm equipment such as plough and combine harvester is as the result of technology.
- ✓ Improved Transportation. Technology has helped in the invention of cars, airplanes, ships and trains to facilitate the movement of goods and people from one place to another.

- ✓ Improved Education. Teaching and learning processes in schools have improved as a result of the invention of modernized teaching aids such as electronic boards, slide projectors, computers, videos etc.
- ✓ Improved Sanitation. Effective ways of solid and liquid waste disposal and recycling methods, which are the result of technology, have helped us to keep our environment clean.
- ✓ Discovery of new energy sources. By the application of technology, we have discovered and developed energy sources, which include hydroelectric power stations, solar energy and biogas to produce electricity and other forms of energy.

**Technological advancements in the world and their positive impacts on the Ghanaian environment:**

1. Renewable Energy Technologies: Advancements in renewable energy, such as solar and wind power, can help reduce Ghana's reliance on fossil fuels and decrease carbon emissions. This can contribute to mitigating climate change and improving air quality.

2. Precision Farming Techniques: The use of precision farming techniques, such as GPS-guided machinery and sensors, can help optimize resource usage in agriculture. This can lead to more efficient farming practices, reduced use of water and fertilizers, and minimized environmental impacts.

3. Waste Management Technologies: Technological advancements in waste management, such as recycling and waste-to-energy systems, can help reduce the amount of waste sent to landfills and promote a circular economy. This can contribute to reducing pollution and conserving natural resources.

4. Environmental Monitoring Systems: Advanced monitoring systems, including remote sensing and satellite imagery, can help track and analyze environmental changes in Ghana. This information can be used to make informed decisions and implement effective environmental management strategies

**Technological advancements in the world and their negative impacts on the Ghanaian environment:**

**1. Increased use of fossil fuels:** The widespread use of fossil fuels for energy production and transportation has led to increased air pollution in Ghana. This has resulted in respiratory problems and other health issues for the population.

**2. Deforestation due to mining activities:** Technological advancements in mining have led to increased deforestation in Ghana. The extraction of minerals often requires clearing large areas of forests, leading to habitat destruction and loss of biodiversity.

**3. E-waste pollution:** With the advancement of technology, electronic waste (e-waste) has become a significant environmental concern. Improper disposal and recycling of electronic devices in Ghana can lead to the release of toxic chemicals into the environment, contaminating soil and water sources.

**4. Water pollution from industrial activities:** Technological advancements in industries have led to increased production and discharge of pollutants into water bodies. This pollution affects aquatic life and can also contaminate drinking water sources, posing health risks to the Ghanaian population.

5. Production of weapons for robbery

## STRAND 5 HUMANS AND THE ENVIRONMENT
## SUB-STRAND 4 CLIMATE CHANGE AND GREEN ECONOMY
## Explain the concept of climate change and its effects on the environment

**Climate:** is the condition of the atmosphere at a particular location over a long period of time. It is the long-term summation of the atmospheric elements and their variations.

**Climate change**: Is the long term changes to the climate of a region or country, or even the whole world.
The term climate change refers to significant changes in average weather patterns (i.e. Precipitation, temperature, wind and other indicators) that persist within a climate system, caused directly or indirectly by human activities.

### Human activities that influence climate change
- Burning of fossil fuels
- Deforestation
- Industrial activities
- Mining
- Agricultural activities such as bush burning

### Natural factors that influence climate change.

1. **Solar radiation:** Changes in the intensity of solar radiation reaching the Earth's surface can impact climate patterns. Variations in the Sun's energy output, such as solar flares or sunspot activity, can influence the Earth's temperature.

2. **Volcanic activity**: Volcanic eruptions release large amounts of gases and particles into the atmosphere. These volcanic emissions can affect climate by blocking sunlight and cooling the Earth's surface temporarily.

3. **Ocean currents**: Ocean currents play a crucial role in redistributing heat around the globe. Changes in ocean circulation patterns, such as El Niño and La Niña events, can impact regional and global climate patterns.

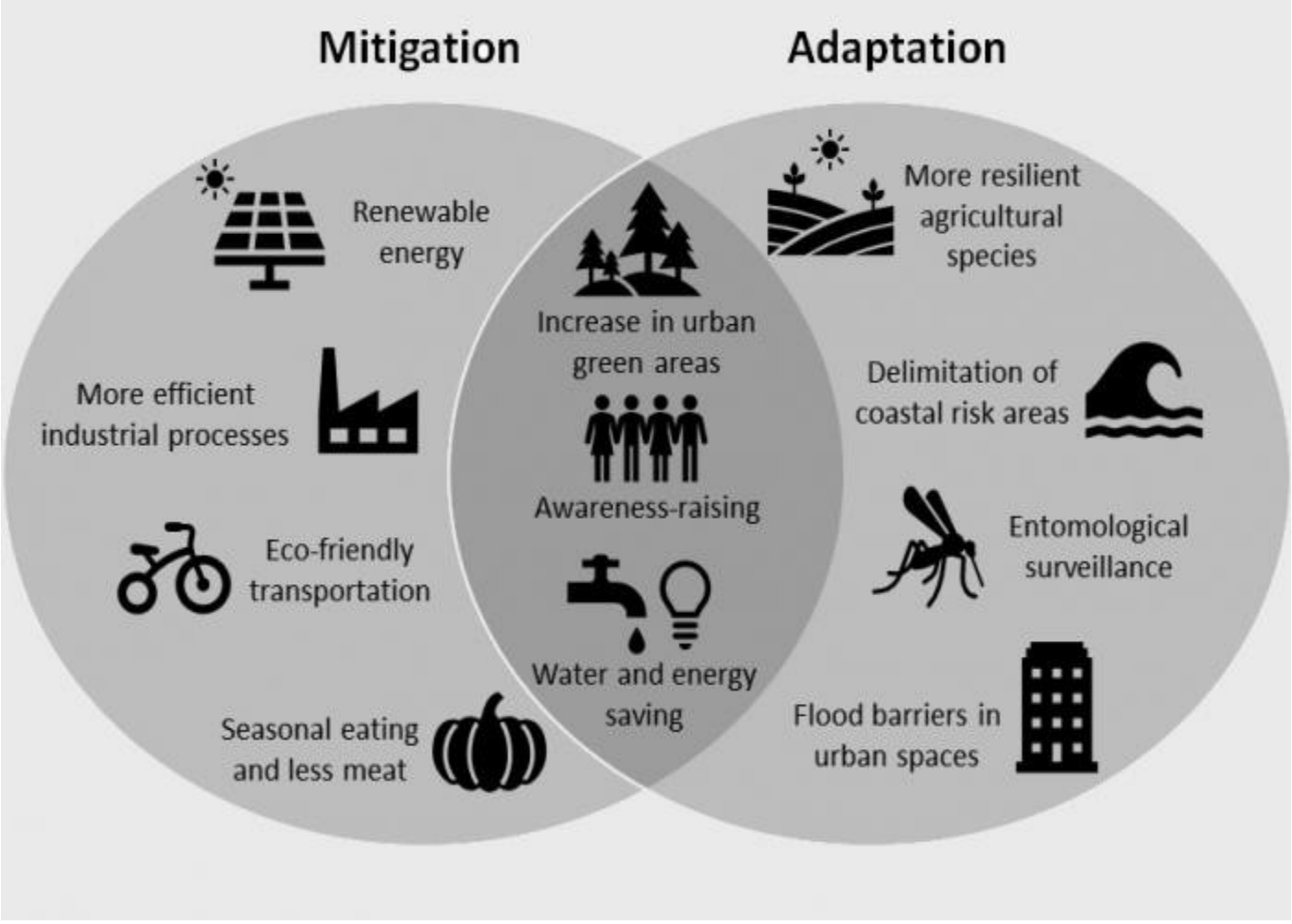
4. **Natural greenhouse gases:** Certain gases, such as carbon dioxide (CO2), methane (CH4), and water vapor, occur naturally in the atmosphere and contribute to the greenhouse effect. Changes in the concentrations of these gases can influence the Earth's climate.

### Effects of climate change on the Environment:
1. Direct physical harm on humans
2. Crop failure and farmland loss
3. Sea level rises and coastal submersion
4. Freshwater loss and desertification

### Effects of climate change on biodiversity resources
- ✓ It changes in vegetation patterns.
- ✓ Changes in plant life cycles
- ✓ Rising levels of sea
- ✓ Warmer oceans
- ✓ Changes in pattern of weather and rainfall.
- ✓ Air and water pollution
- ✓ Population displacement.

**There are several ways to minimize human activities that influence climate change.**
Here are a few examples:
**1. Reduce greenhouse gas emissions**: One of the most effective ways to minimize human activities that contribute to climate change is to reduce greenhouse gas emissions. This can be done by transitioning to renewable energy sources, such as solar or wind power, and by improving energy efficiency in buildings, transportation, and industrial processes.
**2. Promote sustainable transportation:** Encouraging the use of public transportation, carpooling, cycling, and walking can help reduce carbon emissions from transportation. Additionally, supporting the development and adoption of electric vehicles can also contribute to minimizing the impact of human activities on climate change.
**3. Practice sustainable agriculture**: Implementing sustainable agricultural practices, such as organic farming, agroforestry, and precision farming techniques, can help reduce greenhouse gas emissions from the agricultural sector. These practices can also improve soil health and water conservation.
**4. Support reforestation and afforestation**: Planting trees and restoring forests can help absorb carbon dioxide from the atmosphere, as trees act as natural carbon sinks. Supporting initiatives that promote reforestation and afforestation can help mitigate the impact of human activities on climate change.

## Climate change mitigation and adaptation



## Climate change mitigation

**Climate change mitigation** *refers to efforts and actions taken to reduce or prevent the long-term effects of climate change.*

It involves reducing greenhouse gas emissions, promoting renewable energy sources, improving energy efficiency, implementing sustainable land use practices, and adopting other measures to limit the impact of human activities on the climate.
These actions aim to slow down the rate of global warming and minimize the negative consequences of climate change on the environment, ecosystems, and human societies.

**Ways to mitigate climate change.**

1. Transitioning to renewable energy sources such as solar, wind, and hydropower.
2. Improving energy efficiency in buildings, transportation, and industrial processes.
3. Reducing deforestation and promoting reforestation to enhance carbon sequestration.
4. Implementing sustainable agricultural practices to reduce greenhouse gas emissions.
5. Encouraging the use of electric vehicles and public transportation to reduce emissions from transportation.
6. Promoting recycling and waste reduction to minimize methane emissions from landfills.
7. Enhancing international cooperation and agreements to address climate change on a global scale.
8. Educating and raising awareness about climate change to encourage individual and collective action.
9. Investing in research and development of innovative technologies to further reduce emissions.
10. Implementing policies and regulations that incentivize sustainable practices and penalize high-emission activities.

**Climate change adaptation**

*It refers to the process of adjusting to the impacts of climate change in order to reduce vulnerability and build resilience*. **OR**
*It is the process of adjusting to the current and future effects of climate change.*
It involves taking actions to prepare for and respond to the changing climate conditions, such as extreme weather events, rising sea levels, and shifts in temperature and precipitation patterns.

Climate change adaptation can include measures like building infrastructure that can withstand climate-related hazards, implementing early warning systems, developing drought-resistant crops, and implementing policies to protect vulnerable communities. The goal of climate change adaptation is to minimize the negative impacts of climate change and ensure that societies and ecosystems can adapt and thrive in a changing climate.

**Ways to adapt to climate change.**

Here are some strategies:
1. Enhancing infrastructure resilience: This involves designing and constructing buildings, roads, and other infrastructure to withstand extreme weather events such as floods, storms, and heatwaves.
2. Implementing water management strategies: This includes improving water storage and distribution systems, promoting water conservation, and implementing measures to manage droughts and floods.
3. Developing sustainable agriculture practices: This involves promoting climate-smart agriculture techniques such as crop diversification, agroforestry, and efficient irrigation methods to adapt to changing weather patterns.
4. Protecting ecosystems: Preserving and restoring natural ecosystems like forests, wetlands, and coral reefs can help mitigate the impacts of climate change by providing natural buffers against extreme weather events and supporting biodiversity.
5. Enhancing early warning systems: Developing and implementing effective early warning systems can help communities prepare for and respond to climate-related hazards such as hurricanes, wildfires, and heatwaves.
6. Promoting sustainable urban planning: Designing cities and urban areas to be more resilient to climate change by incorporating green spaces, improving drainage systems, and reducing heat island effects.
7. Raising awareness and education: Educating communities about the impacts of climate change and providing information on adaptation strategies can empower individuals and communities to Take action and make informed decisions

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 5: UNDERSTANDING THE ENVIRONMENT
## BASIC 8. 5.55.1.1 Discuss the physical properties of soil.

**Definition of soil**
Soil is the weathered part of loose organic and inorganic materials of the earth crust where plants grow or life exists.

**Functions or importance of soil**
- Soils provides anchorage for roots, hold water and nutrients.
- Soils serves as a source of material for construction, medicine, art etc.
- Soils act as a living filter of clean water before it moves into an aquifer.
- It acts as a recycling system for nutrients and organic waste.
- Soils modify the atmosphere by emitting and absorbing gases (carbon dioxide, methane, water vapor, and the like) and dust.
- It serves as a medium of crop production.

**Major Components of soil**
- Soil particle.
- Mineral salts
- Air or oxygen
- Moisture or water
- Living organisms.

**How soil is formed**
- Soil is formed when rocks weather or breakdown to form soil particles.
- Dead remains of organisms are acted upon by micro-organisms and all mix together.

**Physical properties of soil**
1. Texture: Refers to the relative proportions of sand, silt, and clay particles in the soil, which affects its ability to retain water and nutrients.
2. Structure: Describes how soil particles are arranged and clumped together, influencing its ability to hold water, allow root penetration, and support plant growth.
3. Color: Indicates the presence of different minerals and organic matter in the soil, which can provide clues about its fertility and drainage.
4. Porosity: Refers to the amount and size of spaces or pores between soil particles, affecting water infiltration, air circulation, and root development.
5. Permeability: Measures how easily water can move through the soil, which is influenced by its texture, structure, and porosity.
6. Moisture content: Indicates the amount of water present in the soil, which affects plant growth and microbial activity.
7. Density: Measures the mass of soil per unit volume, which can impact root penetration, water movement, and nutrient availability.
8. Ph level: Reflects the acidity or alkalinity of the soil, influencing nutrient availability and microbial activity.
9. Organic matter content: Refers to the amount of decomposed plant and animal material in the soil, which improves its fertility, water-holding capacity, and nutrient availability.
10. Nutrient content: Describes the concentration of essential elements like nitrogen, phosphorus, and potassium in the soil, which are crucial for plant growth and development.

**Types of soil**
**a. Clay soil** **b. Sandy soil** **c. Loamy soil**

**Properties of clay soil**
- Particles are small or fine or smooth or compact.
- Poorly aerated or can retain water or hold water or waterlogged.
- Easily cracks when dry.
- Has high nutrient or mineral holding capacity.
- Sticky when wet.

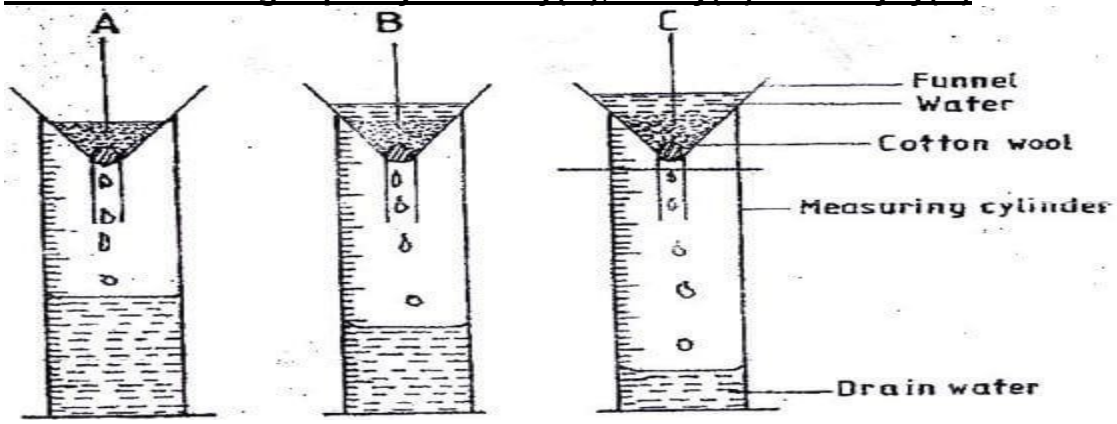
**Properties of sandy soil**

- Well aerated or large air spaces.
- Good drainage or cannot retain or hold water.
- Low nutrient or mineral holding capacity.

**Properties of loamy soil**
- Contains equal quantities of clay and sand particles.
- Particle sizes are between that of sandy soil and a clay soil.
- Contains right proportion of plant and animal nutrients.
- Has moderate water drainage ability or water holding capacity.
- Has air spacing between that of clay and sand or fairly aerated or moderately aerated.

**Qualities of loam or loamy soil that makes it suitable for crop production**
- It can be easily tilled or worked on.
- It contains high amount of organic matter or humus/ it is fertile.
- It is well aerated or porous.
- It is easily drained.
- It is lighter in weight.

**The water holding capacity of sandy(A), loamy(B) and clayey(C)**




**The water holding capacity of soil** refers to the amount of water that can be retained in the soil after excess water has drained away.

**Clayey soil (C)** *has high water holding capacity due to its small particle size and high surface area, which allows it to retain water.*

**Loamy soil (B)** *has moderate water holding capacity because it is a mixture of sand, silt, and clay, providing a balance of drainage and water retention*.

**Sandy soil (A)** *has low water holding capacity because of its large particle size and low surface area, leading to rapid drainage and less water retention.*

**Living organisms commonly found in loamy soils.**

| | | | | |
|---|---|---|---|---|
| A.Bacteria | b.Earthworm | c.Centipede | d.Fungi | e.Millipede |
| F.Nematode | g.Termites | h. Ants. | | |

**Reasons why sandy soil is not suitable for crop production**
- Poor in nutrients or poor fertility.
- Highly susceptible to leaching.
- Heats up easily during sunny weather.
- Poor water-holding capacity or high drainage.
- Presence of few micro-organisms.

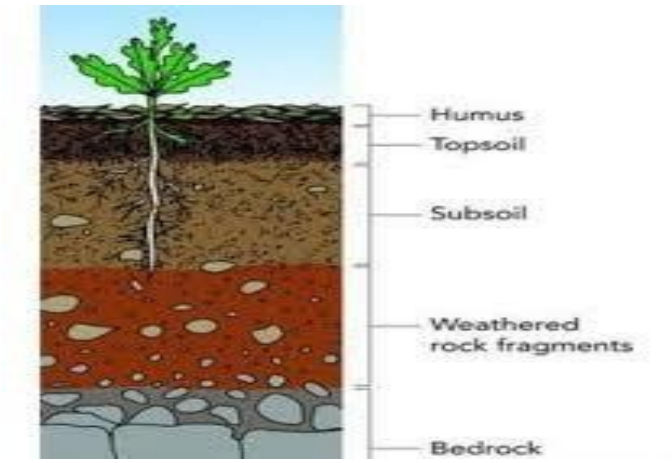
**Ways by which sandy soil could be improved for crop production.**
- Addition of inorganic fertilizers.

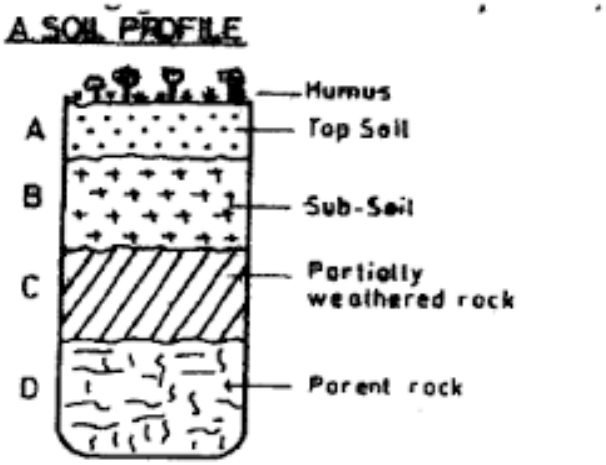
- Addition of farm yard manures or compost.
- Liming.
- Addition of powdered clay.
- Mulching with organic materials.
- Growing of legumes or addition of nutrients.

**Advantages of clayey soil over sandy soil**

- Clayey soil contains high amount of nutrients.
- Clayey soil retains high amount of water or moisture.
- Clay can be moulded into various shapes when wet.
- Clay is not easily eroded due to its compact nature.
- Clay does not heat up easily.

**Soil profile.** A soil profile is a vertical cross-section of the soil that reveals its various layers or horizons. These layers are formed through the accumulation and transformation of materials over time, influenced by factors such as climate, topography, vegetation, and human activity. A typical soil profile consists of several distinct horizons, each with its own characteristics.




**The soil consist of layers or horizons**

1. Top soil or A horizon
2. Sub soil or B horizon
3. Weathered rock or C horizon
4. Bedrock or D horizon

**1. Topsoil or A Horizon:** The topsoil, also known as the A horizon, is the uppermost layer of soil. It is characterized by a mixture of organic matter, minerals, and microorganisms, making it crucial for supporting plant growth. This layer is rich in nutrients and humus, which is the result of organic material decomposition. The topsoil is often darker in color due to the presence of organic matter and is where most plant roots are concentrated.

**2. Subsoil or B Horizon**: The subsoil, represented by the B horizon, lies beneath the topsoil. It contains a lower concentration of organic matter compared to the A horizon and is enriched with minerals leached from the overlying layers. The subsoil often exhibits distinct characteristics such as clay accumulation, iron oxide staining, or other mineral deposits. Its properties can significantly impact drainage and root penetration.

**3. Weathered Rock or C Horizon**: The weathered rock horizon, known as the C horizon, consists of partially broken-down parent material that has undergone weathering processes but has not yet transformed into true soil. This layer contains a mixture of weathered rock fragments and minerals, often with limited organic content. It serves as a transition zone between the soil and the underlying bedrock. No living micro-organism is present.

**4. Bedrock or D Horizon:** The bedrock, also referred to as the R horizon, represents the solid rock material that underlies all the other soil horizons. It is largely unweathered and serves as the ultimate

source of mineral components for soil formation. The characteristics of the bedrock can influence factors such as soil depth, nutrient availability, and water retention.

**Importance of the soil profile**
1. Soil profiles provide insights into soil fertility and nutrient availability.
2. They help assess drainage properties and water retention capacities of the soil.
3. Soil profiles aid in understanding the potential for erosion and soil conservation strategies.
4. It helps farmers to know the types tool to be used on a particular soil
5. It helps farmers to know the types crop to be grown on a particular soil

**Liming** this is the process whereby certain calcium compounds or ashes are added to the soil to reduce acidity of the soil.

**Advantages of liming**
- Improvement in soil structure.
- Efficiency and effective use of agrochemicals such as herbicides.
- Better performance of soil micro/macro organisms.
- Enhances control of soil-borne plant diseases.
- Enhancement of absorption and utilization of essential elements.
- Reduces soil acidity.

**Soil resources**
They are physical and chemical materials in the soil which support effective plant growth.
**Note: The three main soil resources are**: water, air and nutrients (macro and micro nutrients).

**Human activities that result in the depletion of soil resources.**
- Overgrazing.
- Poor farming/Tillage methods/ Over cropping/ Bush burning.
- Excessive use of fertilizer.
- Improper irrigation practices.
- Deforestation.
- Surface mining
- Quarrying.
- Dumping of non – biodegradable waste on land.

**Soil conservation**
This refers to all the activities that aim at maintaining or improving or protecting the soil and its resources. Soil can be conserved by;
- Preventing soil erosion
- Preserving soil fertility.

**Soil fertility** This is a soil that contains the needed crop nutrient (in right quantities) for proper crop growth. **OR Soil fertility** is the ability of the soil to support effective crop growth.

**Fertile soil** This is a soil that contains all the necessary nutrients or minerals needed by plants for growth/development. **Or** it is a soil that supports plants healthy growth/ development.

**Conditions under which a fertile soil will not be productive.**
- Nutrients not able to dissolve/ nutrients not available to crops.
- Types of farming method used.
- Unavailability of oxygen to crop roots.
- Lack of water or excessive drought.
- Waterlogging.
- Erosion.
- Unsuitable temperature.
- Presence of weeds on the farm.

**Qualities of fertile soil**
- Adequate supply of plant nutrients or minerals.
- Adequate supply of air.
- Rich in organic matter or manure or humus.
- Sufficient supply of micro-organisms.
- Good soil texture or structure.

- Favourable soil ph.
- Adequate moisture or water.
- Low leaching capacity

**Ways in which cover cropping aids in soil fertility**

- Conserving soil moisture by drastically reducing evaporation from the soil.
- Prevents nutrient uptake by weeds.
- Preventing soil erosion to maintain nutrients in the top soil.
- Cools the soil, creating the right conditions for soil organisms.
- Litter from cover crops constitutes a good source of soil organic matter.

**Factors that cause depletion of soil fertility or ways in which nutrients are lost from the soil.**

- Soil erosion
- Leaching: This is the washing down of some of the important nutrients to lower levels beyond the reach of plant roots by rain water.
- Bush burning
- Over cropping or continuous cultivation.
- Surface compaction: This normally brought about by people and livestock walking over the soil.
- Overgrazing by animals exposes soil surfaces to erosion.
- Crop removal: Exposes soil to rain and sun which can lead to leaching, surface compaction and loss of soil moisture.

**How Crop removal causes loss of soil nutrients**

Harvesting by taking the entire crop plant from the farm denies the land of organic matter that would have resulted from the decay of the plant. **Or** harvesting by taking the entire crop plant from the farm leaves the ground bare leading to loss of nutrients by erosion.

**How Continuous cropping causes loss of soil nutrients**

Continuous cropping leads to constant removal of nutrients from the land by plants. The land is not allowed to rest in order to regain fertility.

**How drainage causes loss of soil nutrients**

Nutrients that dissolved in the soil water are removed together with the excess water thereby depriving the soil of its nutrients. **Or** water washes away the top soil (humus) thereby depriving the soil of its nutrients.

**Ways of improving or maintaining soil fertility**

a. Cover cropping b. Green manuring c. Crop rotation d. Terracing
e. Mixed farming f. Irrigation g. Bush fallowing.

**How plants absorb water and nutrients from the soil through osmosis.**

Plants have specialized structures called roots that are responsible for absorbing water and nutrients from the soil. The root system consists of tiny root hairs, which are located on the surface of the roots. These root hairs increase the surface area of the roots, allowing for more efficient absorption.

Osmosis is the process by which water and dissolved nutrients move from an area of higher concentration to an area of lower concentration through a semi-permeable membrane. In the case of plants, the root hairs act as the semi-permeable membrane.

When the soil is moist, it contains a higher concentration of water and dissolved nutrients compared to the root hairs. As a result, water and nutrients move into the root hairs through osmosis. This movement is driven by the difference in concentration between the soil and the root hairs.

Once inside the root hairs, the water and nutrients are transported through the roots and up the stem to the rest of the plant. This upward movement is facilitated by specialized tissues called xylem and phloem. *In summary, plants absorb water and nutrients from the soil through osmosis, which is the movement of water and dissolved substances from an area of higher concentration to an area of lower concentration through a semi-permeable membrane.*

## BASIC 9

## STRAND 1: DIVERSITY OF MATTER
## SUB-STRAND 1: MATERIALS
### B9.1.1.1.1 Identify by name binary chemical compounds and discuss their uses

**A compound** is a substance that is made up of two or more different elements chemically bonded together. These elements can be either metals or non-metals. Examples of compounds include water ($H_2O$), table salt (nacl), and carbon dioxide ($CO_2$).

Here are some common compounds used at home, school, and in the community, along with the elements present in each compound:

1. **Water (H2O)** - Elements: Hydrogen (H) and Oxygen (O)
2. **Table Salt (nacl**) - Elements: Sodium (Na) and Chlorine (Cl)
3. **Baking Soda (nahco3)** - Elements: Sodium (Na), Hydrogen (H), Carbon (C), and Oxygen (O)
4. **Sugar (C12H22O11)** - Elements: Carbon (C), Hydrogen (H), and Oxygen (O)
5. **Vinegar (CH3COOH)** - Elements: Carbon (C), Hydrogen (H), and Oxygen (O)
6. **Ammonia (NH3)** - Elements: Nitrogen (N) and Hydrogen (H)
7. **Carbon Dioxide (CO2)** - Elements: Carbon (C) and Oxygen (O)
8. **Oxygen Gas (O2)** - Element: Oxygen (O)
9. **Hydrochloric Acid (hcl)** - Elements: Hydrogen (H) and Chlorine (Cl)
10. **Ethanol (C2H5OH)** - Elements: Carbon (C), Hydrogen (H), and Oxygen (O)

**Differences between elements and compounds**

| Elements | Compounds |
|---|---|
| Cannot be broken down into any simpler substances. | It can be broken down into simpler substances. |
| It is made up of the same kind of atoms. | Consists of atom of different elements. |
| Have their own set of properties. | Properties differ from those of their constituents. |

**The distinction between elements, molecules, and ions:**

1. **Element**: An element is a pure substance that cannot be broken down into simpler substances by chemical means. It consists of only one type of atom. Examples of elements include oxygen (O), hydrogen (H), and carbon (C).

2. **Molecule:** A molecule is a group of two or more atoms held together by chemical bonds. It can be made up of the same type of atoms (as in oxygen gas, $O_2$) or different types of atoms (as in water, H2O). Molecules can be either elements or compounds.

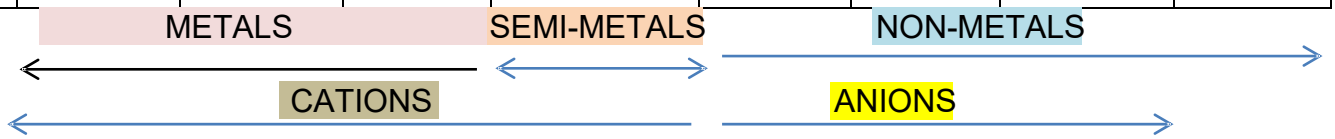
3. **Ion:** An ion is an atom or a group of atoms that has gained or lost electrons, resulting in a positive or negative charge. When an atom loses electrons, it becomes a positively charged ion called a cation. When an atom gains electrons, it becomes a negatively charged ion called an anion. Ions can be formed from both elements and compounds.

**A binary compound** is a type of compound that is composed of two different elements. These elements can be either metals and nonmetals or two nonmetals. Binary compounds can be classified into different types based on the type of bond present between the elements.

**A. Binary ionic compounds** are formed when a metal and a nonmetal combine through an ionic bond. *Binary ionic compounds are compounds that are formed between a metal and a nonmetal*. In these compounds, the metal donates electrons to the nonmetal, resulting in the formation of positive and negative ions. The positive and negative ions are then attracted to each other, forming an ionic bond . They conduct electricity when melted or dissolved in water.

**Periodic table** is the arrangement of elements according to their increasing atomic numbers. On the periodic table elements with similar properties are placed in vertical rows (called period) and horizontal columns (called group).

| | GROUP 1 | GROUP 2 | GROUP 3 | GROUP 4 | GROUP 5 | GROUP 6 | GROUP 7 | GROUP 8 |
|---|---|---|---|---|---|---|---|---|
| PERIOD 1 | 1 H | | | | | | | 2 He |
| PERIOD 2 | 3 Li | 4 Be | 5 B | 6 C | 7 N | 8 O | 9 F | 10 Ne |
| PERIOD 3 | 11 Na | 12 Mg | 13 Al | 14 Si | 15 P | 16 S | 17 Cl | 18 Ar |
| PERIOD 4 | 19 K | 20 Ca | | | | | | |
| | Alkali metals | Alkaline earth metals | | | | | Halogens | Noble gas |
| Charges | +1 | +2 | +3 | +4 | -3 | -2 | -1 | 0 |
| Valency | 1 | 2 | 3 | 4 | 3 | 2 | 1 | 0 |







**To form binary ionic compound,**

1. Identify the metals in the periodic table. Eg. Sodium, potassium, lithium etc

2. Identify the non-metals in the periodic table and change the last three or two letters to ide or de. Eg oxygen-oxide, fluorine-fluoride, chlorine-chloride, nitrogen- nitride, phosphorus-phosphide etc.

3. Combined the metals and non-metals to form binary ionic compound. Eg.

| | |
|---|---|
| Sodium + chlorine | Sodium chloride |
| Calcium + fluorine | Calcium fluoride |
| Beryllium + oxygen | Beryllium oxide |
| Magnesium + sulphur | Magnesium sulphide. Etc |

**NOTE**. For metals their names remain the same, it only the non-metals that the name changes.

**The molecular formula** is a representation of a compound that shows the number and types of atoms present in a molecule. It provides information about the composition of the molecule. For example, the molecular formula for water is H2O, which indicates that there are two hydrogen atoms (H) and one oxygen atom (O) in each water molecule

***To write the molecular formula of an ionic compound,*** you would typically:

**1.** Identify the cation (positive ion) and anion (negative ion) present in the compound and represent them with their chemical symbols.

**2.** Determine the charges of the cation and anion.

**3**. Balance the charges of the cation and anion to achieve a neutral compound. If the charges are the same cancel the charges. But if the charges are not the same exchange the valency of the elements to the lower right of each of the element (chemical symbol)

**Please note** that this is a general approach, and the specific steps may vary depending on the compound. It's always best to consult a reliable source or reference material for the specific ionic compounds you are working with

**Examples**

**1. Sodium chloride.**

Na Cl……identify the cations and anions represent them with their chemical symbols.
$Na^+$ $Cl^-$…… Determine the charges of the cation and anion
$Na^+$ $Cl^-$…… The charges are the same so cancel the charges.
Since the charges are the same, the molecular formula of sodium chloride =**nacl**

**2. Magnesium phosphide**

Mg P….. Identify the cations and anions represent them with their chemical symbols.
$Mg^{2+}$ $P^{3-}$…. Determine the charges of the cation and anion.
$Mg^{2+}$ $P^{3-}$…… The charges are not the same so exchange the valency of the elements to the lower right of each of the element (chemical symbol) $Mg_3P_2$ .The molecular formula of magnesium phosphide = **$Mg_3P_2$**

**3. Lithium nitride**

Li N….. Identify the cations and anions represent them with their chemical symbols.
$Li^+$ $N^{3-}$… Determine the charges of the cation and anion.
$Li^+$ $N^{3-}$… the charges are not the same so exchange the valency of the elements to the lower right of each of the element (chemical symbol) $Li_3N$. The molecular formula of Lithium nitride = **$Li_3N$** .

| **Binary compound** | **IUPAC/Systematic name** |
|---|---|
| Hcl | Hydrogen chloride |
| Kcl | Potassium chloride |
| Nacl | Sodium chloride |
| Mgs | Magnesium sulphide |
| | Hydrogen sulphide |
| Mgc | Magnesium chloride |
| Alc | Aluminium chloride |

**Write the molecular formula of the following**

1. Sodium phosphide 2. Aluminium oxide 3. Magnesium oxide 4. Aluminium chloride 5. Lithium chloride etc.

**B. Binary molecular (covalent) compounds**

Binary molecular (covalent) compounds are formed as the result of a reaction between two nonmetals. Although there are no ions in these compounds, they are named in a similar manner to binary ionic compounds. Some examples of binary covalent or molecular compounds are water (H2O), carbon dioxide ($CO_2$), methane ($CH_4$), ammonia ($NH_3$), hydrogen chloride (hcl), and sulfur dioxide ($SO_2$).

**To form binary molecular compound**,

1. Identify two non-metals. Eg sulphur and oxygen, carbon and oxygen, nitrogen and oxygen, hydrogen and chlorine, hydrogen and oxygen.
2. The first element in the compound is given first, the element's full name is maintained. Roman numerals can be attached the first element to indicate it charge. Eg. Sulphur (IV) , Carbon (IV) etc.
3. The second element is named as if it were an anion. Change the last three or two letters to ide or de. Eg oxygen-oxide, fluorine-fluoride, chlorine-chloride, nitrogen- nitride, phosphorus-phosphide
4. Combined the two non-metals to form binary molecular compound.

Eg.

| **Element presents.** | **Compound** |
|---|---|
| Sulphur (IV) +oxygen | Sulphur (IV) oxide |
| Nitrogen + oxygen | Nitrogen oxide |
| Hydrogen(II)+oxygen | Dihydrogen oxide |
| Carbon (IV) +oxygen | Carbon (IV) oxide |

**To write the molecular formula of binary molecular compound**

1. Identify the elements present in the compound. For example

S O

2. Determine the charge of the of the **second element only from the periodic table**.

S $O^{2-}$

3. Determine the charge of the first element using the roman numerals as the charge of the first element.

$S^{2+}$ $O^{2-}$

4. Balance the charges of the two non-metals to achieve a neutral compound. If the charges are the same cancel the charges. But if the charges are not the same exchange the valency of the elements to the lower right of each of the element (chemical symbol).

Eg $S^{2+}$ $O^{2-}$ the charges are the same so cancel the charges. The molecular formula of Sulphur (II) oxide is **SO**.

**Note** The above procedure can be used to write the chemical or molecular formula of ionic or molecular compounds that are given in systematic name.eg. Copper (IV) oxide to $cuo_2$.

**EXAMPLES**

**1. Carbon (IV) oxide**

C O…. Identify the elements present in the compound

C $O^{2-}$… Determine the charge of the of the **second element only.**

$C^{4+}$ $O^{2-}$….Determine the charge of the first element using the roman numeral as the charge of the first element.

If the charges are not the same exchange the valency of the elements to the lower right of each of the element (chemical symbol) as done beblow.

$C^{4+}$ $O^{2-}$..

$C_2$ $O_4$..

$C_{2/2}$ $O_{4/2}$ if the subscript of the element has a Common factors, then you solve and cancel out or if the subscript of the element has no Common factors, then you leave it.

**$CO_2$** is the molecular formula of **Carbon (IV) oxide**.

**2. Sulphur (IV) oxide**

S O….. Identify the elements present in the compound

S $O^{2-}$… Determine the charge of the of the **second element only.**

$S^{4+}$ $O^{2-}$… Determine the charge of the first element using the roman numeral as the charge of the first element.

If the charges are not the same exchange the valency of the elements to the lower right of each of the element (chemical symbol) as done beblow.

$S^{4+}$ $O^{2-}$…

$S_{2/2}$ $O_{4/2}$.... If the subscript of the element has a Common factors, then you solve and cancel out or if the subscript of the element has no Common factors, then you leave it.

**$SO_2$** is the molecular formular of **Sulphur (IV) oxide**

**<u>How to write the systematic name using roman numerals when molecular or chemical formula has been given for both ionic and molecular compounds.</u>**

1. Identify the elements present in the compound.
2. Determine the charge of the of the **second element only from the periodic table**.
3. Determine the charge of the first element.

A. To determine charge of the first element, represent the charge of the first element as any variable (x).eg. $S^XO^{2-}$

B. Equate the charges of the elements involves to zero (0) and find the value of variable (x).

Eg X+(-2)=0, x=+2, since x has crossed the equal to sign to become positive.

OR find the oxidation number of the first element.

4. Use the roman numerals to represent the charge of the first element.

Eg. The charge of Sulphur =+2. This becomes Sulphur (II).

5. Finally, write the first element name, followed by the roman numerals then the second element name Changing the last three or two letters to ide or de. Eg oxygen-oxide, fluorine-fluoride, chlorine-chloride, nitrogen- nitride, phosphorus-phosphide.

**<u>Example</u>**

**1. Fes**

A. Fe S… Identify the elements present in the compound

B. Fe $S^{2-}$... Determine the charge of the of the **second element only from the periodic table**.

C. $Fe^x$ $S^{2-}$… determine charge of the first element, represent the charge of the first element as any variable (x)

D. $Fe^xs^{2-}$ =0…… Equate the charges of the elements involves to zero (0) and find the variable (x).

X+(-2)=0 → x-2=0, → x= +2. Since x has crossed the equal to sign to become positive.

Use the roman numerals to represent the charge of the first element. The charge of Sulphur =+2. This becomes Sulphur (II).

**E. Iron (II) suiphide**…, write the first element name, followed by the roman numerals then the second element name Changing the last three or two letters to ide or de of the second element.

**2. $CO_2$**

**A**.C O…. Identify the elements present in the compound

**B**.C $O^{2-}$… Determine the charge of the of the **second element only.**

**C**. $C^X$ $O^{2-}$…. Determine charge of the first element, represent the charge of the first element as any variable (x)

**D.** $C^XO^{2-}$=0…… Equate the charges of the elements involves to zero (0) and find the variable (x). X+(-2*2)=0..the charge of the oxygen was multiply by two (2) because there are two atoms of oxygen. ⟶ X-4=0 ⟶ x=+4.. Since x has crossed the equal to sign to become positive .
Use the roman numerals to represent the charge of the first element. The charge of carbon is +4. This becomes Carbon (IV)

**E. Carbon (IV) oxide**….write the first element name, followed by the roman numerals then the second element name Changing the last three or two letters to ide or de of the second element.

| **Binary compound** | **IUPAC name** |
|---|---|
| C | Carbon (IV) oxide |
| Znc | Zinc (II) chloride |
| Mno | Manganese (II) oxide |
| Cuo | Copper (II) oxide |
| | Nitrogen(I) oxide |
| S | Sulphur (IV) oxide |
| CO | Carbon (II) oxide |

**How to write the systematic name using prefixes when molecular or chemical formula has been given for both ionic and molecular compounds.**

1. Determine the number of atoms of each element in the compound. This can be done by looking at the subscripts in the chemical formula. For example, in water (H2O), there are two hydrogen atoms and one oxygen atom.

2. Use prefixes to indicate the number of atoms of each element.
The prefixes used in naming binary molecular compounds are:
Mono- (**only used for the second element if there is only one atom**)
Di- (two atoms)
Tri- (three atoms)
Tetra- (four atoms)
Penta- (five atoms)
Hexa- (six atoms), hepta- (seven atoms), octa- (eight atoms), nona- (nine atoms), and deca- (ten atoms). Etc.

3. Write the name of the first element, using the appropriate prefix if needed. For example, in water (H2O), the first element is hydrogen, so we write "dihydrogen".

4. Write the name of the second element, using the appropriate prefix if needed. For example, in water (H2O), the second element is oxygen, so we write "oxide".

5. Combine the names of the elements, with the second element's name ending in "-ide". For example, in water (H2O), we combine "dihydrogen" and "oxide" to get "dihydrogen oxide".

**Figure 1**

| Ionic Compounds | |
|---|---|
| **Formula** | **Name** |
| NaCl | sodium chloride |
| CdS | cadmium sulfide |
| $CaI_2$ | calcium iodide |
| LiCl | lithium chloride |
| $Na_2O$ | sodium oxide |
| $Al_3C_4$ | aluminum carbide |
| $BaF_2$ | barium fluoride |
| $Mg_3N_2$ | magnesium nitride |

**Figure 2**

| Binary Molecular Compounds | |
|---|---|
| **Formula** | **Name** |
| CO | carbon monoxide |
| $CO_2$ | carbon dioxide |
| $SO_2$ | sulfur dioxide |
| NO | nitrogen monoxide |
| $S_2Cl_2$ | disulfur dichloride |
| $N_2O$ | dinitrogen monoxide |
| $CCl_4$ | carbon tetrachloride |
| $PCl_5$ | phosphorus pentachloride |

**Differences between Ionic compound and Molecular compound**

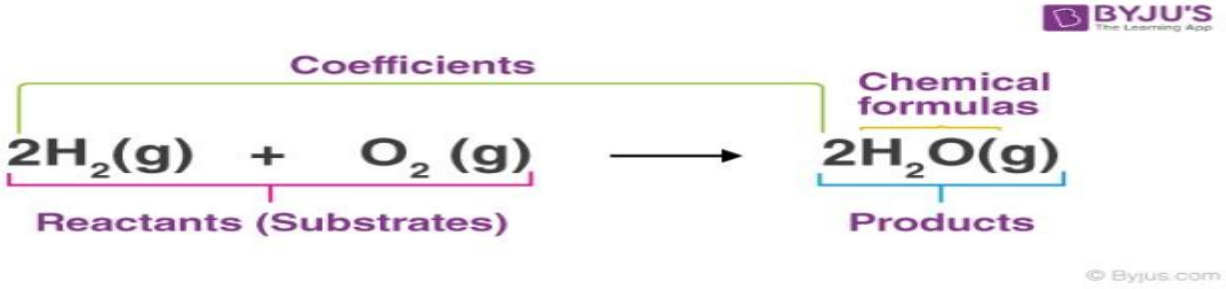
| **Ionic compound** | **Molecular compound** |
|---|---|
| Exist mostly as solid | Exist in the three state of matter |
| They are aggregates of ions | They exist as molecules |
| They conduct electricity in solution | They are non conductors |
| They are mostly soluble in organic solvent | They are mostly soluble in water but insoluble in organic solvent |

**C. Binary acidic compounds:** These compounds are formed when a hydrogen ion (H+) combines with an anion. Examples include hydrochloric acid (hcl) and sulfuric acid (H2SO4).

**D. Binary basic compounds:** These compounds are formed when a metal hydroxide reacts with an acid to form water and a salt. Examples include sodium hydroxide (naoh) and calcium hydroxide ($Ca(OH)_2$).

## BALANCING OF CHEMICAL EQUATION

A chemical equation is a symbolic representation of a chemical reaction. It uses chemical formulas and symbols to show the reactants, products, and the physical states of the substances involved in the reaction. The equation provides valuable information about the substances that are reacting, the substances that are being formed, and the stoichiometry of the reaction.
In a chemical equation, the reactants are written on the left-hand side of the arrow, while the products are written on the right-hand side. The arrow indicates the direction of the reaction.



**Steps to follow when writing chemical equation**

**A. A word equation is written for the reaction**
Eg hydrogen + oxygen ⟶ water

**B. The symbols and formulae of the reactant and products are written under their names in the word equation**
Eg hydrogen + oxygen ⟶ water
$H_2$ + $O_2$ ⟶ $H_2O$

**C. The equation is then balanced to ensure that the number of atoms of element in the reactant is equal to that of the product.**
$H_2$ + $O_2$ ⟶ $H_2O$
H=2 H=2
O=2 O=1
From above illustration, you could see that the equation is not balance because oxygen o, it number of atoms in the product is not balance to the reactant. So start the balancing from the atom that is not balanced. In this we will start the balancing from oxygen O.
1. $H_2$ + $O_2$ ⟶ $H_2O$
H=2 H=2
O=2 O=1×2=2
2. Once you balance the oxygen the result is written as the coefficient in front of the compound its found in.
This is coefficient in front of the compound affect the other atom which is hydrogen so you adjust the hydrogen atom in both the reactant and the products.
$2H_2$ + $O_2$ ⟶ $2H_2O$
H=2×2=4 H=2×2=4
O=2 O=1×2=2
From above, you could see that the equation is balanced.

**Examples**
1. Carbon react with Oxygen to produce Carbon dioxide
C + $O_2$ ⟶ $CO_2$
C= 1 C= 1
O=2 O= 2
From above, you could see that the equation is balanced.

2. Nitrogen react hydrogen to produce Ammonia

3. Sodium react with chlorine to produce sodium chloride

4. HCL + NaOH ⟶

5. $H_2$ + Cl ⟶

## B9.1.1.1.3 Describe the characteristics of common acids, bases and salts

### CONCEPTS OF ACIDS AND BASES AND SALTS

**Acids:** They are compounds that release hydrogen ions ($H^+$) when dissolved in water.
Acids have a sour taste and can react with metals, carbonates, and bases.
They are proton (  ) donors.

**Acids are group into two main types**

A. Organic acid
B. Inorganic acid

**Organic acid**

They are acid that are obtained from plant and animal.
Organic acids are like the sour and tangy flavors you taste in certain foods. They are special kinds of compounds that are often found in fruits, vinegar, and even in sour milk. These acids have a unique group of atoms called the "carboxyl group," which gives them their special properties.

For example, when you taste the tangy flavor in an orange or lemon, you're actually tasting a type of organic acid called citric acid. This acid gives these fruits their refreshing taste.
Organic acids are also used to preserve food and give it a nice flavor. Have you ever wondered why pickles taste tangy? That's because they're made using a type of organic acid called acetic acid, which is also found in vinegar.
There are several sources of acids. Some common sources include:

| Organic acid | Source of organic acid |
|---|---|
| Citric acid | Citrus fruits such as oranges, lemons, etc. |
| Formic acid | Sting of ants, bees |
| Acetic acid | Vinegar, Tomato |
| Malic acid | Apple, Grape |
| Tartaric acid | Tamarind, grapes, unripe mangoes, etc. |
| Oxalic acid | Spinach, Cabbage |
| Lactic acid | Curd, milk |
| Ascorbic acid (Vitamin C) | Citrus fruits, amla |

**Inorganic acid**

These acids are obtained from inorganic matters. They are normally produced in the laboratory from the reaction of minerals.
Inorganic acids are like the opposite of the yummy fruits and tangy flavors we talked about with organic acids. They are special kinds of compounds that can be found in things like cleaning products and even in your stomach to help with digestion.

Inorganic acids are made up of different kinds of atoms, and they can be really strong and powerful. For example, have you ever noticed how some cleaning products have a strong smell? That's because they contain inorganic acids that help clean things by breaking down dirt and grime.
One common inorganic acid is hydrochloric acid, which is found in our stomachs to help us digest our food. It's not something we taste or eat directly, but it's important for our bodies to work properly.

Inorganic acids also play a big role in science and industry. They are used in making certain materials, producing electricity, and even in some types of medicine.
Acids can be classified as either strong or weak based on their ability to donate protons (H+ ions) in a chemical reaction**.**

**Here are some examples of inorganic acids along with their chemical formulas:**
1. Hydrochloric acid - hcl
2. Sulfuric acid – $H_2SO_4$
3. Nitric acid - $HNO_3$
4. Phosphoric acid - $H_3PO_4$
5. Carbonic acid – $H_2CO_3$

**The strength of an acid is determined by its dissociation constant, which is a measure of how readily it donates protons. Strong acids have a high dissociation constant, while weak acids have a low dissociation constant.**

**Strong acids:** Strong acids completely dissociate in water, meaning they release all of their protons. This results in a high concentration of H+ ions in the solution. Examples of strong acids include hydrochloric acid (hcl), sulfuric acid ($H_2SO_4$), and nitric acid ($HNO_3$).

**Weak acids**: Weak acids only partially dissociate in water, meaning they release only a small fraction of their protons. This results in a lower concentration of H+ ions in the solution. Examples of weak acids include acetic acid (CH3COOH), citric acid (C6H8O7), and carbonic acid (H2CO3).

**Differences each between weak acid and strong acid.**

| Weak acid | Strong acid |
|---|---|
| Partially ionizes in water | Fully dissociates in water |
| Produces fewer ions in solution | Produces more ions in solution |
| Has a lower conductivity in solution | Exhibits higher conductivity in solution |
| Ph closer to neutral | Ph typically higher (greater than 7) |

**The properties of acids include:**
1. Sour taste: Acids generally have a sour taste. However, it is important to note that tasting acids can be dangerous and should not be done without proper precautions.
2. Reactivity with metals: Acids can react with certain metals, producing hydrogen gas and a salt. This reaction is known as a metal-acid reaction.
3. Corrosive nature: Acids have the ability to corrode or eat away at certain materials, such as metals and even human tissue. This is why acids should be handled with caution.
4. Ph below 7: Acids have a ph value below 7 on the ph scale. The lower the ph value, the stronger the acid.
5. Ability to donate protons: Acids are substances that can donate protons (H+ ions) in a chemical reaction.
6. Turn blue litmus red.

## Chemical properties of Acids and Bases

**Acids:**

A. Acids react with carbonate or bicarbonate compounds to give carbon dioxide gas.
E.g. Cac + 2hcl(aq) + cac + (l)

B. Acids react with reactive metals to give hydrogen gas.
E.g. Zn(s) + 2hcl(aq) +

C. Acids react with bases to give salt and water **only** (a process called **neutralization reaction**).
E.g. Hcl + naoh

**Bases**

They are compounds that release hydroxide ions ($OH^-$) when dissolved in water.
Bases typically have a bitter taste, feel slippery, turn litmus paper blue, and have a ph value greater than 7. They are proton ( ) acceptors. Bases can be found in various substances such as metal hydroxides (e.g., sodium hydroxide, potassium hydroxide), metal carbonates (e.g., calcium carbonate), and metal oxides (e.g., magnesium oxide). These substances can be naturally occurring minerals or synthesized in laboratories

**Types of base**

**A. Organic base**

These are bases that occur naturally in plants and animals. Organic bases are important in various chemical reactions and biological processes. They can also be found in everyday products, such as household cleaners and certain types of dyes.

| **Organic base** | **Source** |
|---|---|
| Potassium hydroxide | Ashes of plant, plantain peels |
| Ammonia | Decay of organic matter |
| Calcium oxides | Limestones heated, oyster shells |
| Alkaloids | Seeds. Roots |
| Amines | Fishes |

**B. Inorganic base**

These are bases that are produce from inorganic matter in the laboratory. Examples are
1. Sodium hydroxide (naoh) (caustic soda)
2. Potassium hydroxide (KOH)
3. Calcium hydroxide (Ca(OH)2)
4. Ammonium hydroxide (NH4OH)

## Strong bases and weak bases.

**A strong base** is a substance that completely dissociates in water to produce hydroxide ions (OH-). This means that when a strong base is dissolved in water, it will release a high concentration of hydroxide ions. Examples of strong bases include sodium hydroxide (naoh) and potassium hydroxide (KOH).

**A weak base** is a substance that only partially dissociates in water to produce hydroxide ions. This means that when a weak base is dissolved in water, it will release a lower concentration of hydroxide ions compared to a strong base. Examples of weak bases include ammonia (NH3) and methylamine (CH3NH2).

**The properties of bases include:**

1. Bitter taste: Bases generally have a bitter taste. This can be observed in substances like baking soda (sodium bicarbonate) or toothpaste.

2. Slippery or soapy feel: Bases have a slippery or soapy feel when touched. This is why soap solutions feel slippery when applied to the skin.
3. Ability to neutralize acids: Bases can neutralize acids by reacting with them to form water and a salt. This is known as an acid-base reaction.
4. Ph greater than 7: Bases have a ph value greater than 7 on the ph scale. The ph scale measures the acidity or alkalinity of a substance, with values below 7 being acidic, 7 being neutral, and above 7 being alkaline or basic.
5. Reactivity with certain metals: Bases can react with certain metals to produce hydrogen gas. For example, sodium hydroxide can react with aluminum to produce hydrogen gas
6. Turn red litmus blue.

**Chemical properties of Base**

- Bases react with acids to form salt and water only.

- Bases react with ammonium salt to give ammonia gas.

E.g. N + naoh

**Neutral solutions** *are solutions that have a ph level of 7, which is considered neither acidic nor basic*. In a neutral solution, the concentration of hydrogen ions (H+) is equal to the concentration of hydroxide ions (OH-). Examples of neutral solutions include pure water or distilled water, sea water, sodium chloride (common salt), sodium nitrate.

## Salts

**Salts** are compounds formed when an acid reacts with a base. **Or**
These are substances formed when the hydrogen atom of an acid is replaced with a metal or ammonium ion in a reaction.

They are made up of positive ions (cations) and negative ions (anions). Salts are typically formed through a neutralization reaction, where the hydrogen ions from the acid combine with the hydroxide ions from the base to form water, leaving behind the salt. Some examples of salts include sodium chloride (table salt), calcium carbonate (chalk), potassium nitrate (saltpeter), and magnesium sulfate (Epsom salt).

**General properties of salts include:**
1. Solubility: Many salts are soluble in water, meaning they can dissolve in water to form a homogeneous solution.
2. Ionic Nature: Salts are composed of ions, which are electrically charged particles. They typically consist of a positively charged cation and a negatively charged anion.
3. Crystal Structure: Salts often form crystals with a regular, repeating pattern. This is due to the arrangement of ions in the solid state.
4. Melting and Boiling Points: Salts generally have high melting and boiling points compared to molecular compounds. This is because the ionic bonds between the ions in the salt require more energy to break.
5. Conductivity: When dissolved in water or melted, salts can conduct electricity due to the presence of ions that are free to move and carry electric charge.
6. They have no effect on litmus paper
7. They a sharp taste
8. They are corrosive when concentrated.

## Types of salts

1. **Normal salt:** It is formed when all the replaceable hydrogen ions of an acid are replaced with metal cations.

E.g. Nacl, cac Etc.
**Note**: There is no presence of hydrogen in normal salts.

2. **Acid salt:** It is formed when only some of the replaceable hydrogen ions are replaced with metal cations.

E.g. Nahc

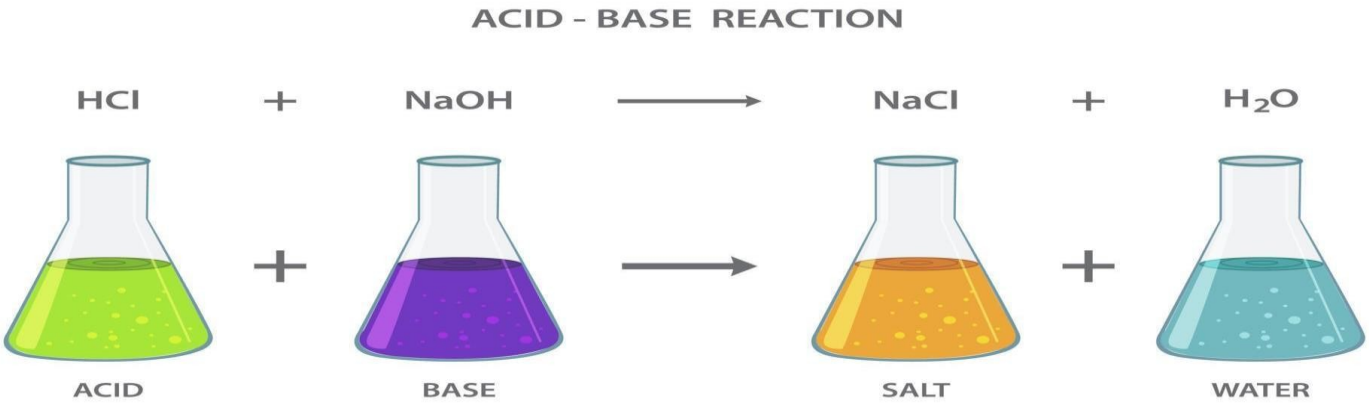
**Note:** There is a presence of hydrogen in acid salt.

3. **Double salt**: e.g. Kal(S Fe(N Etc.

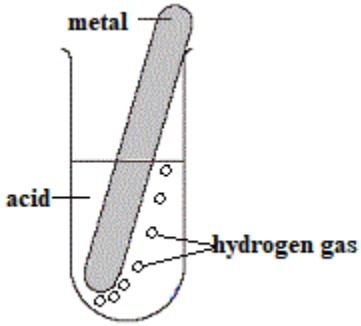
4. **Complex salt:** e.g. Ca[ Fe(CN ].

**Methods of preparing salts.**

**A. By neutralization-** *A neutralization reaction is a chemical reaction that occurs when an acid and a base react with each other to produce water and a salt* ***only***. This reaction is called "neutralization" because it results in the neutralization of the acidic and basic properties of the reactants.




**B. By reacting acid and a metal** *When an acid reacts with a metal, it forms a salt and releases hydrogen gas.* . Zn(s) + 2hcl(aq) +




**C. By reacting an acid with the trioxocarbonate**. *Acids react with carbonate or bicarbonate compounds to give carbon dioxide gas.*

E.g. Cac + 2HCL(aq) + CaC + (l)

## Acid –Base Indicators

Acid –base indicators are weak complex organic acids or bases which ionize or dissolve or dissociate slightly or partially in aqueous solution. **Or.**

Thsese are indicators that show one colour in acidic solution and different colour in basic solution.

### Examples of Acid-base indicators

- Litmus
- Methyl orange
- Methyl red
- Phenolphthalein.

**Note:** A mixture of acid-base indicators is called a **universal indicator.**
**A universal indicator** is therefore an indicator which changes colour several times over a wide range of .

**Differences between Acid-base indicator and Universal indicator**

| Acid- base indicator | Universal indicator |
|---|---|
| 1. Contains single pure compound. | 1. Contains a mixture of compounds/ indicators. |
| 2. Gives two distinct colours. | 2. Gives wide range of colours. |
| 3. Used to determine the acidity or alkalinity of a solution. | 3. Used to determine the Of a solution. |

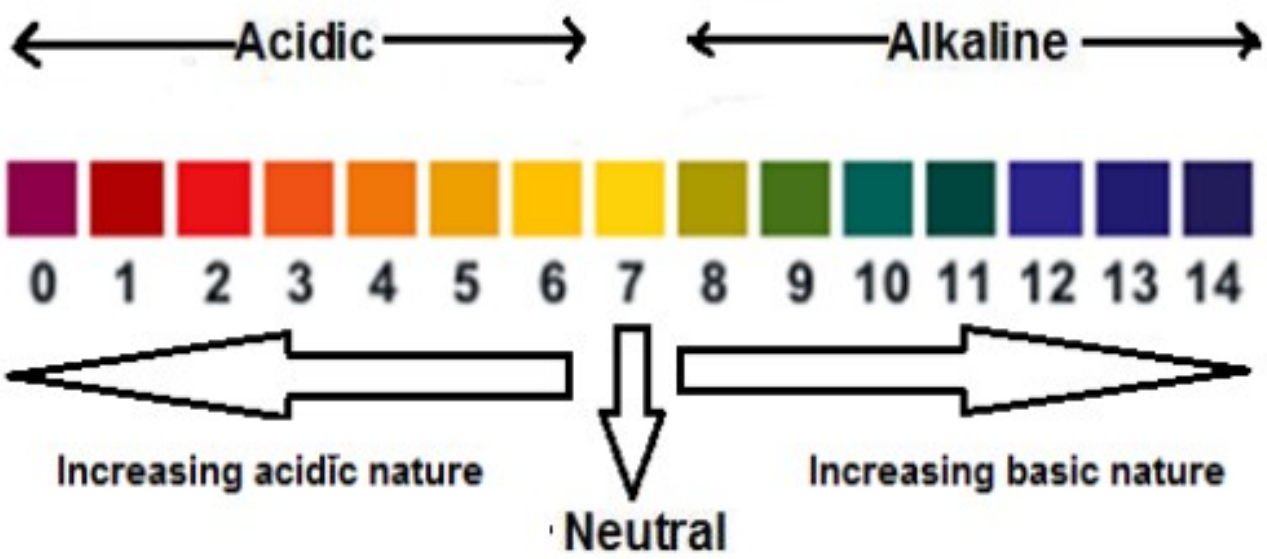
**Chemical nature of Acid-Base Indicators**

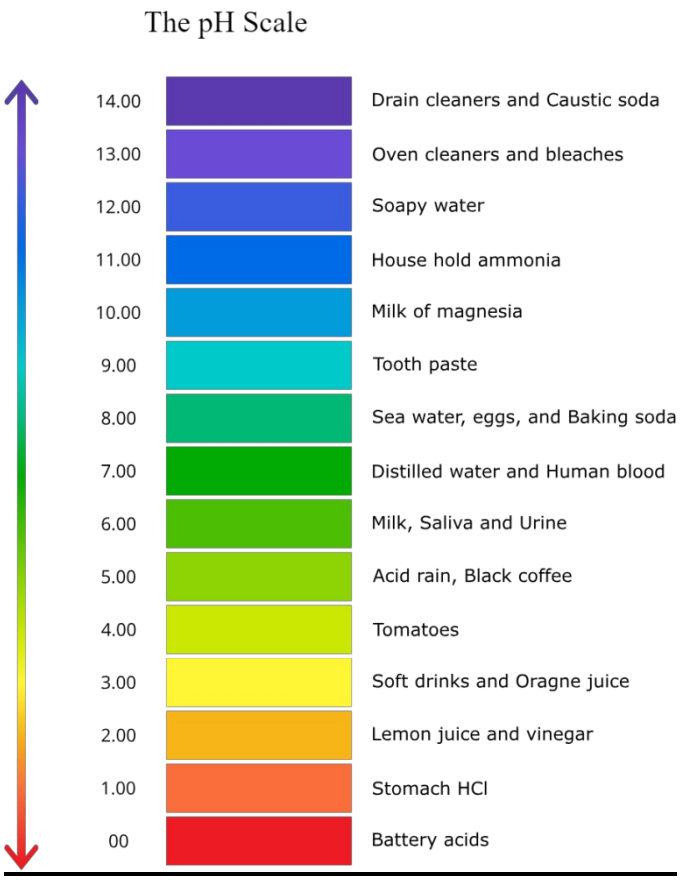
| Indicator | Colour in acid solution | Colour in base/alkaline solution | Colour in neutral solution |
|---|---|---|---|
| Phenolphthalein | Colourless | Red /pink | Colourless |
| Methyl orange | Red/pink | Yellow | Orange |
| Litmus | Red | Blue | Purple |
| Universal | Red | Purple | Green |

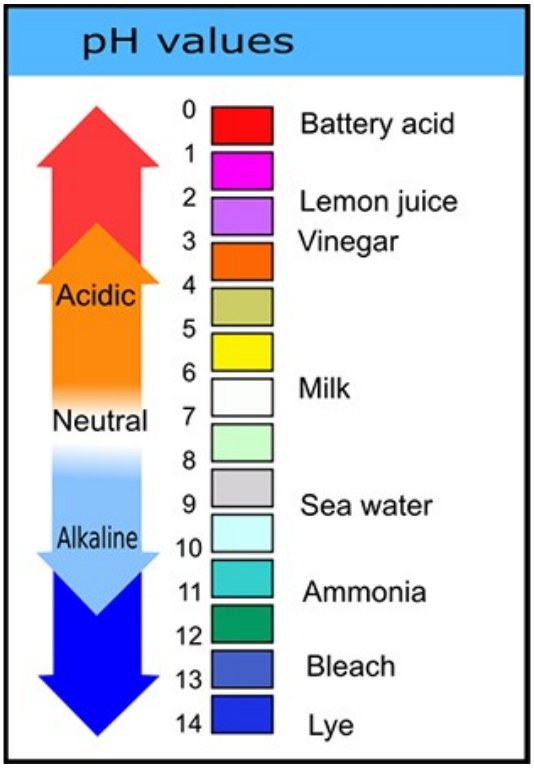
**The ph scale** is a measure of the acidity or alkalinity of a solution. It ranges from 0 to 14, with 7 being considered neutral. A ph value below 7 indicates acidity, while a ph value above 7 indicates alkalinity.

The ph scale is logarithmic, meaning that each unit represents a tenfold difference in acidity or alkalinity. For example, a solution with a ph of 4 is ten times more acidic than a solution with a ph of 5.

The ph scale is commonly used in chemistry and biology to measure the acidity or alkalinity of substances such as water, soil, and body fluids.





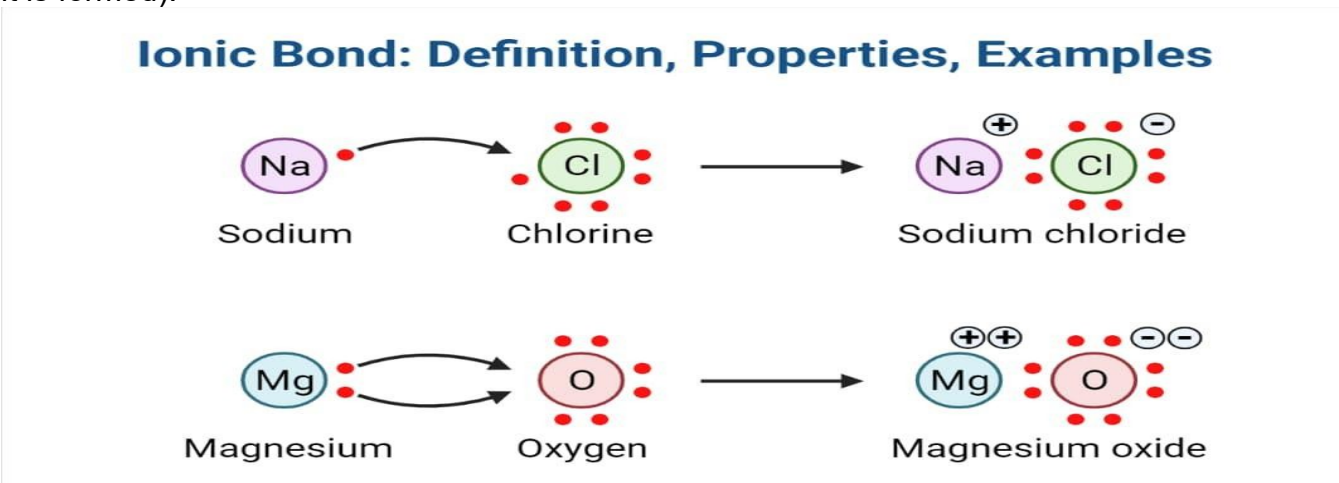

**B9.1.1.2.1 Recognize that chemical bond results from the attraction between atoms in a compound**

## CHEMICAL BONDING

The joining together of atoms is called bonding. Bonds are formed between atoms when electrons are redistributed among those atoms involved in the bonding process.

### Types of Chemical Bonding

**1.Electrovalent/ionic bonding**: It is the force of attraction between the oppositely charged ions which have been formed by electron transfer. (i.e. What it means).
It is formed when there is a complete transfer of electron(s) from one atom to another atom. (i.e. How it is formed).



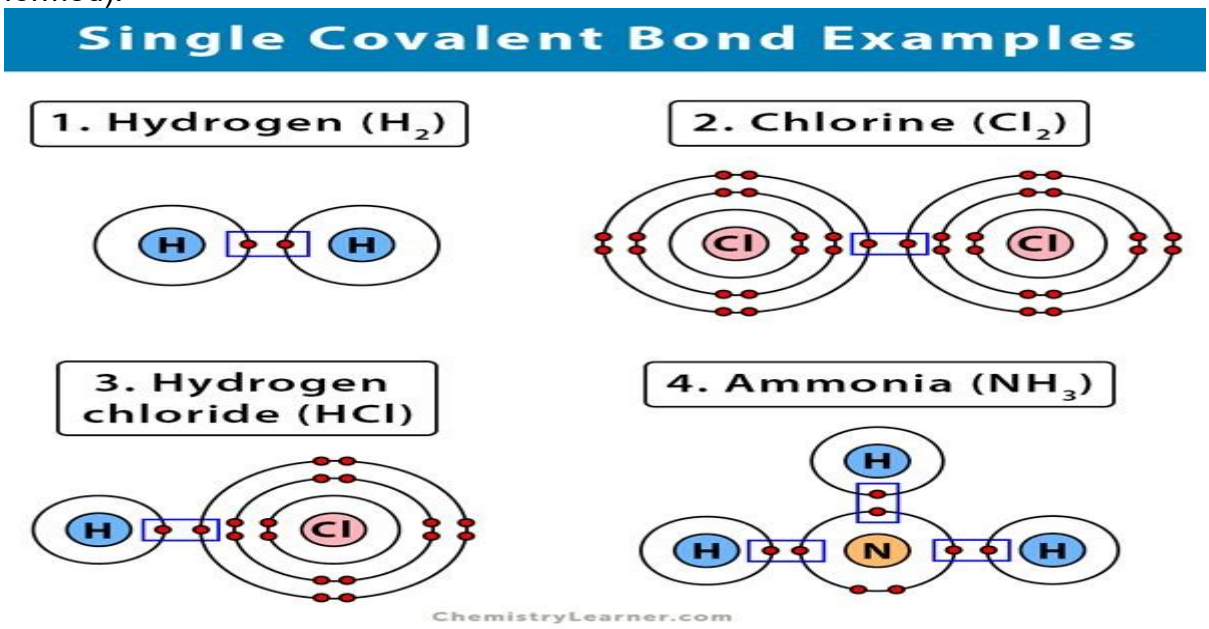

### Examples of compounds with ionic bonds

Calcium oxide(cao) Copper(II) oxide(cuo)
Sodium chloride(nacl) Sodium oxide(N )

Potassium oxide(  )
Calcium chloride(cac  )
Magnesium chloride(mgc  )

Copper(II) Trioxonitrate
Ammonium chloride(N  )
Magnesium oxide(mgo)

**2.Covalent/molecular bonding**: It involves the sharing of electrons between two atoms. (i.e. What it means).
It is formed by the sharing of pair(s) of electrons between the two atoms involved. (i.e. How it is formed).




**Examples of compounds with covalent bonds**

A. Ethanol  b. Hydrogen chloride (hcl)  c. Ethane
D. Carbon dioxide(C  )  e. Water(  )  f. Chlorine molecule(C  )
G. Hydrogen molecule(  )  i. Oxygen molecule(  )  j. Ammonia (N  ).

**Differences between Ionic & Covalent compounds**

| • **Electrovalent/Ionic compounds** | • **Molecular/ Covalent compounds.** |
|---|---|
| • High melting point. | • 1. Low melting point. |
| • High boiling point. | • 2. Low boiling point. |
| • Most are solids at room temperature hence have high densities. | • 3. Usually gas or liquid at room temperature. |
| • Conduct heat and electricity in molten or aqueous solutions. | • 4. Do not conduct electricity in aqueous solution. |
| • Reactions happen quickly | • 5. Reactions happen slowly. |
| • Soluble in water. | • 6. Insoluble in water. |
| • Made up of ions.<br>• 8. Form crystals. | • Made up of molecules.<br>• 8. Do not form crystals. |

## Reasons ionic compounds have high melting & boiling points than covalent compounds

Ionic compounds have very strong attractive or electrostatic forces between bonded positive and negative ions. Therefore, large amount of energy is needed to break these strong electrostatic forces between the particles.

## Differences between Ionic & Covalent bonds

| Ionic Bond | Covalent Bond |
|---|---|
| Transfer of electrons from one of the bonding pairs to another. | Electrons are shared between two bonding pairs. |
| Only one of the bonding pairs contributes electrons. | 2. Each bonding pairs contributes electrons to the bond. |

## Metallic Bond

A metallic bond is a type of chemical bond that holds metal atoms together. It is like a strong glue that keeps the metal atoms connected to each other. This bond allows metals to have their unique properties, such as being shiny, malleable (able to be hammered into different shapes), and conductive (able to carry electricity and heat). It's like a special bond that makes metals special and useful for many things, like making jewelry, coins, and even building structures . Examples of metallic bonds include:

1. Copper: Copper is a metal that forms metallic bonds. It is used in electrical wiring because it is a good conductor of electricity.

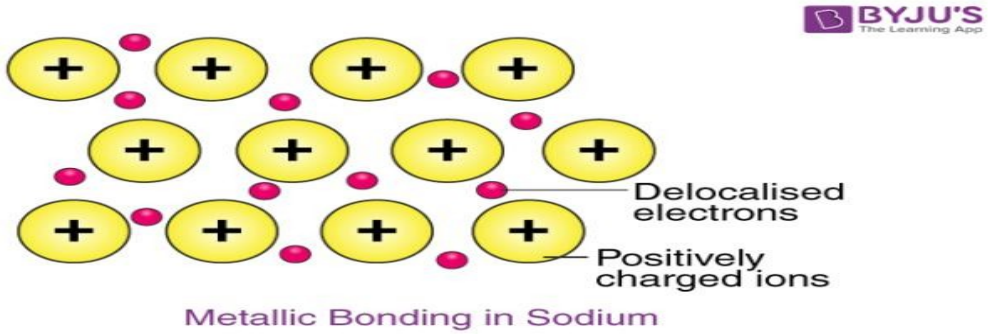
2. Iron: Iron is another metal that forms metallic bonds. It is used to make tools, buildings, and even cars because it is strong and durable.

3. Gold: Gold is a precious metal that forms metallic bonds. It is used to make jewelry because it is shiny and doesn't tarnish easily.

4. Aluminum: Aluminum is a lightweight metal that forms metallic bonds. It is used in the construction of airplanes and soda cans because it is strong and resistant to corrosion.

## Formation of metallic bonds

Metallic bonds are formed between metal atoms. In a metallic bond, the outermost electrons of the metal atoms are delocalized, meaning they are not associated with any specific atom.
These delocalized electrons are free to move throughout the metal lattice, creating a "sea" of electrons. The positive metal ions are surrounded by this sea of electrons, which holds the metal atoms together. This sharing of electrons between metal atoms is what forms the metallic bond.



Metallic Bonding in Sodium

**Properties of metallic bonds are:**

1. High electrical conductivity.
2. High thermal conductivity.
3. Malleability.
4. Ductility.

## TEST YOUR MIND

1. Where can you find electrons in an atom?
   a. In the center
   b. Around the outside
   c. Touching the center
   d. Atoms don't have electrons
2. What occurs in a covalent bond?
   a. Electrons are shared
   b. Electrons are taken
   c. Electrons are missing
   d. Electrons are added
3. What are the two major categories of matter?
   a. Atoms and molecules
   b. Homogeneous and heterogeneous mixtures
   c. Mixtures and substances
   d. Elements and compounds
4. Sand is dropped into a beaker of iron filings. This is an example of a(n)
   a. Electrolysis.
   b. Element.
   c. Mixture.
   d. Compound.
5. An ionic bond is the attraction between .

a. Similarly charged ions
b. Oppositely charged ions
c. Neutral ions d. Neutral atoms

6. Which of the following is properties of acids?

A. Changes the color of an indicator
B. Sour taste
C. Reacts with metals to produce hydrogen gas
D. Feels slippery

7. Calcium phosphate is present in tooth enamel - its nature is

A. Basic b. Acidic c. Neutral c.amphoteric

8. What methods can you use to measure the ph of a solution?

A. Observing color or clarity
B. Measuring mass or volume
C. Measuring density or electrical conductivity
D. Using acid base-indicators or ph meters

9. Name the reaction which takes place between an acid and a base

A. Displacement b. Neutralization C. Double displacement c. Redox reaction

9. Which of the following word pairs, correctly completes the sentence below? _____ are corrosive substances characterized as having a strong smell, a sour taste, and a _____.

A. Acids; ph less than 7
B. Acids; ph greater than 7
C. Bases; ph greater than 7
D. Bases; ph less than 7

10.Which of the following values would represent the ph of a strong base?

A. 1 b. 8 c. 7 d. 13

## STRAND 1: DIVERSITY OF MATTER
## SUB-STRAND 2: LIVING CELLS
### B9.1.2.1.1 Discuss the concept of specialized cell and how they are formed in dicot plant and human.

**Cell division** is the process by which a parent cell divides into two or more daughter cells. It is a fundamental process in all living organisms and is essential for growth, development, and repair.

**There are two main types of cell division:**

I. Mitosis ii. Meiosis.

**Mitosis** is the type of cell division that occurs in somatic cells and results in the production of two identical daughter cells.

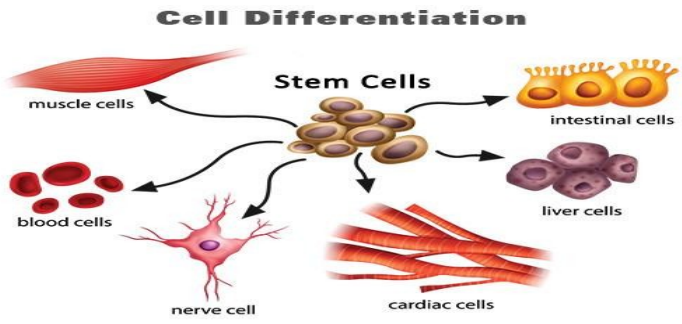
**Meiosis**, on the other hand, is a specialized type of cell division that occurs in reproductive cells and results in the production of four daughter cells with half the number of chromosomes as the parent cell.

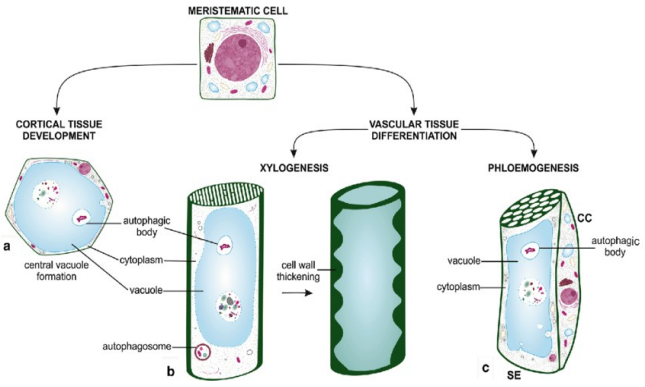
**Differences between mitosis and meiosis**

| Mitosis | Meiosis |
|---|---|
| Takes place in somatic or body cells | Takes place in germ cells or sex cells or reproductive cells. |
| Produces two daughter cells from one parent cell | Produces four daughter cells from one parent cell |
| Occurs in one phase only | Occurs in two phases |
| No pairing up of chromosomes | Pairing up of homologous chromosomes. |
| No exchange of genes | Exchange of genes. |
| Chromosome number is maintained or diploid cells produced. | Chromosome number is halved or haploid cells produced |
| No crossing over or chaisma formation | Crossing over occurs or chaisma formation occurs. |
| Daughter cells identical to parents | Daughter cells not identical to parents. |

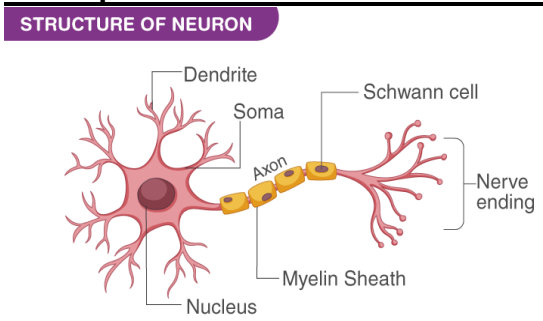
**Specialized cell** This is a cell structurally adapted to perform a particular or specific function. OR *Specialized cells are cells that have specific structures and functions that allow them to perform specific tasks within an organism*. These cells are adapted to carry out specific functions, such as nerve cells that transmit electrical signals, muscle cells that contract and enable movement, or red blood cells that carry oxygen throughout the body. Each type of specialized cell has unique characteristics that make it well-suited for its particular role in the body.

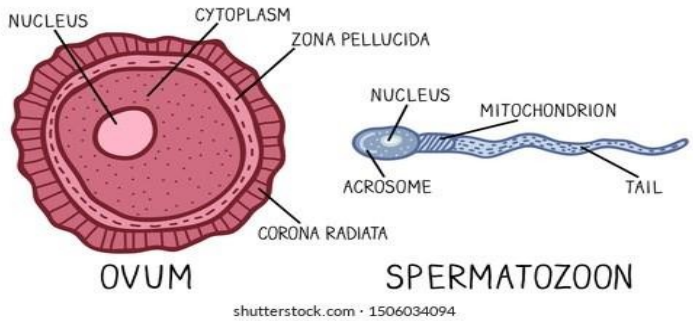
**Cell differentiation** *is the process by which cells become specialized and take on specific functions in the body.* During development, cells undergo changes in gene expression that allow them to acquire unique characteristics and perform specific tasks. This process is essential for the formation of different tissues and organs in the body.

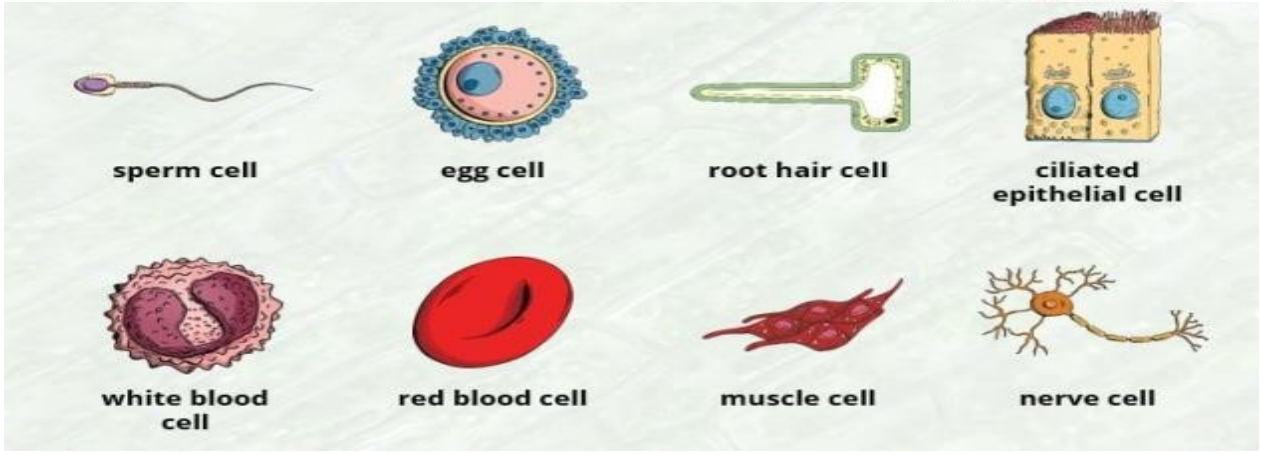


## How specialised cells are formed in humans




***In humans, specialized cells are formed through a process called cell differentiation. During development, the human body starts as a single fertilized egg, which then undergoes multiple rounds of cell division. As these cells divide, they begin to differentiate and specialize into various types of cells that make up different tissues and organs.***

The process of cell differentiation in humans is regulated by a combination of genetic factors and environmental cues. Genes play a crucial role in determining the fate of cells and controlling their specialization. Different genes are activated or repressed in specific cells, leading to the production of proteins and other molecules that give the cells their unique characteristics and functions.

Environmental cues, such as chemical signals and physical interactions with neighboring cells, also play a role in guiding cell differentiation. These cues help to ensure that cells differentiate into the appropriate cell types and are positioned correctly within the developing tissues and organs.

As cells differentiate, they become committed to specific lineages and acquire specialized structures and functions. For example, cells may differentiate into muscle cells, nerve cells, blood cells, or skin cells, among many others. This specialization allows different cells to perform specific tasks and work together to maintain the overall function and health of the human body.

**Examples of Specialized cells found in human body**

| Specialized cells | Function |
|---|---|
| Red blood cell or erythrocyte | ○ Transport oxygen (from lungs to the body).<br>○ Transports carbon dioxide (from the body to the lungs). |
| White blood cell or leukocytes or phagocytes. | ○ Produces antibodies.<br>○ Engulfs bacteria or protect the body against germs or diseases. |
| Sperm cell | ○ Carries genetic information from parent to offspring.<br>○ Fertilizes the ovum or egg. |
| Ovum or egg cell | ○ Provides food store needed for the developing zygote. |

| | |
|---|---|
| | ○ Carries genetics information from mother to offspring or fuses with the sperm. |
| Muscle cell<br>**Types**<br>Skeletal muscle<br>- Smooth muscle.<br><br>Cardiac muscle | ○ Protects delicate organs of the body.<br>○ Contracts and relaxes to cause movement. |
| | ○ Is attached to bones and helps with voluntary movements.<br>○ Is found in the walls of internal organs and blood vessels, helping with involuntary movements<br>○ Tissue is found in the heart and is responsible for the heartbeat. |
| Nerve cell or Neurone | ○ Transmits impulses (from the sensory organ to all parts of the body). |

## Dicotyledonous plants

The flowering plants (angiosperms) are dominated by by two evolutionary groups: monocotyledons and dicotyledons. These groups can be distinguished by the number of embryonic seed leaves (cotyledons), the arrangement of vascular tissue in the stem, leaf venation, and manner of leaf attachment to the stem.

**Dicotyledonous plants**, commonly referred to as dicots, are a group of flowering plants characterized by the presence of two embryonic seed leaves, known as cotyledons, in their seeds. Dicots form a major group within the angiosperms (flowering plants) and exhibit certain distinctive characteristics:

**Dicotyledenous plants tend to exhibit the following characteristics (although exceptions may be found):**

- Two embryo leaves - cotyledons
- Tap root system - one main root with side roots
- Leaves with net venation
- Secondary growth in stems
- Whorls in flowers made up of four or five part

**Examples of dicot plants include a wide variety of familiar species such as**:

-

Roses (Rosa)
- Sunflowers (Helianthus)
- Maple trees (Acer)
- Peas (Pisum)
- Tomatoes (Solanum lycopersicum)
- Oak trees (Quercus)

| MONOCOTS | DICOTS |
|---|---|
| 1. Embryo with single cotyledon | 1. Embryo with two cotyledons |
| 2. Major leaf veins parallel | 2. Major leaf veins reticulated |
| 3. Stem vascular bundles scattered | 3. Stem vascular bundles in a ring |
| 4. Roots are adventitious | 4. Roots develop from radicle |
| 5. Flower parts in multiples of three | 5. Flower parts in multiples of four or five |
| 6. Pollen with single furrow or pore | 6. Pollen with three furrows or pores |
| 7. Secondary growth absent | 7. Secondary growth often present |

## How specialized cells are formed in dicotyledonous plants

***In dicotyledonous plants, specialized cells are formed through a process called cell differentiation. During development, certain cells such as the meristematic cell or the stem cell in the plant undergo changes in gene expression, leading to the formation of different cell types with specific functions.***

**Meristematic cells** are a type of plant tissue found in the meristem, which consists of undifferentiated cells capable of cell division. These cells are responsible for the **growth and development of plants**. This process is regulated by various factors, including hormones and environmental cues.

**There are three primary types of meristems in plants:**

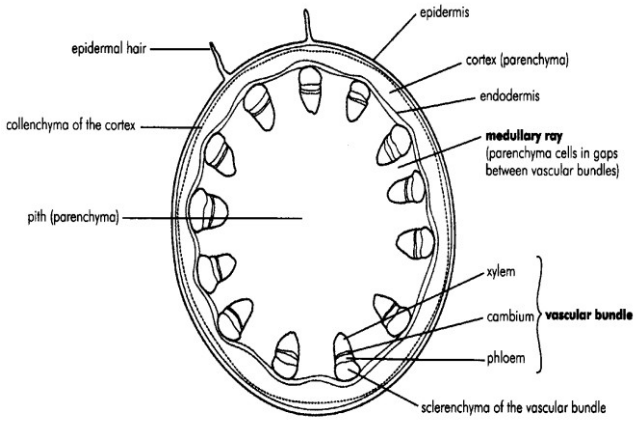
**1. Apical Meristem:** Found at the tips of stems and roots, responsible for primary growth in length.

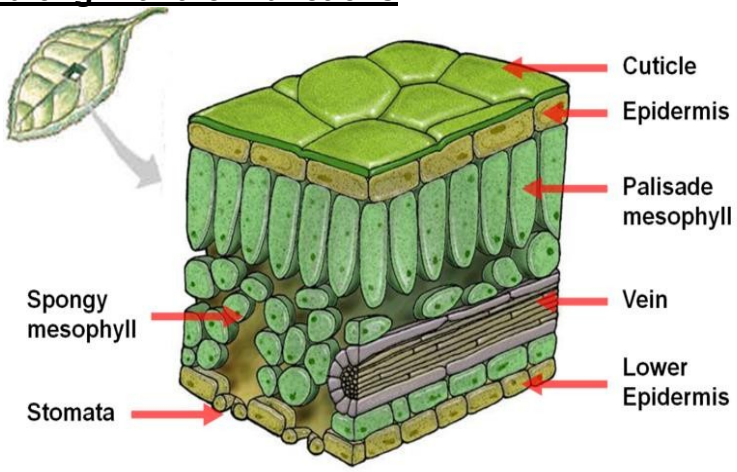
**2. Intercalary or Basal Meristem:** Located at the base of leaves and internodes, contributing to the elongation of plant organs.

**3. Lateral Meristem:** Also known as cambium, found at the sides of stems and roots, involved in secondary growth, leading to an increase in girth.

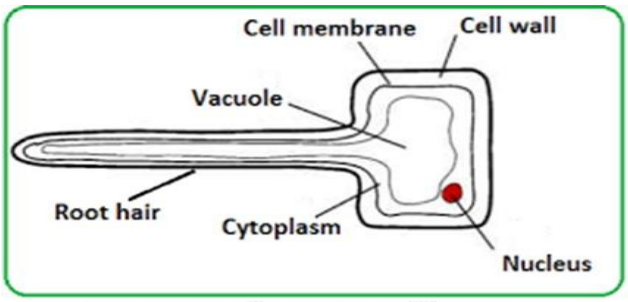
In dicotyledonous plants, **the meristems are responsible for producing new cells**. The apical meristem, located at the tips of the stems and roots, produces cells that differentiate into various tissues, including specialized cells. As the plant grows, the apical meristem gives rise to the ***primary tissues, such as the epidermis, cortex, and vascular tissues.***

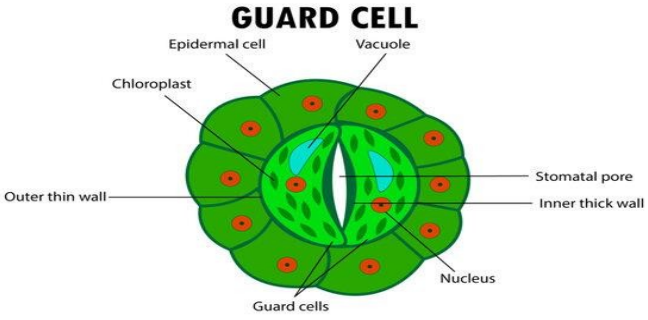
**Specialized cells in a dicotyledonous plant along with their functions**:

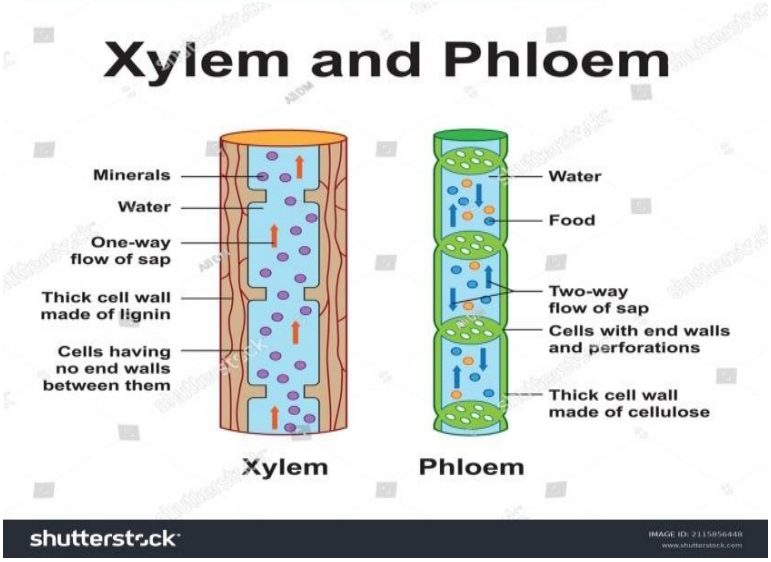


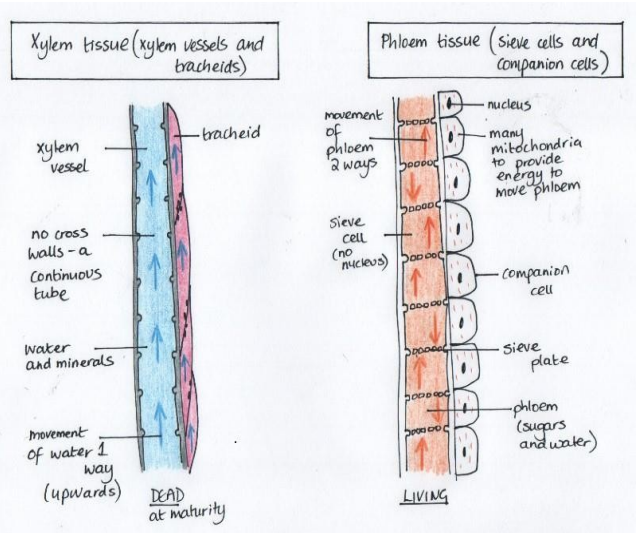




## Root hair cell



## Functions of the the specialized cells in dicot plant

1. **Xylem cells:**. The xylem is a type of vascular tissue in plants, responsible for the transport of water and minerals from the roots to the rest of the plant. It is one of the two types of transport tissue in vascular plants, with the other being phloem.
**A** Xylem Transports water and minerals
**B**it transports minerals in upward direction only
**The xylem is composed of several types of cells, including:**
**A.** Tracheids: Elongated cells with tapered ends that transport water and minerals.
**B**. Vessel Elements: Shorter, wider cells that also aid in water conduction.
**C**. Xylem Parenchyma: Living cells that provide storage and support to the xylem.
**D**. Xylem Fibers: Long, thick-walled cells that contribute to mechanical support.

2. **Phloem cells.** The phloem is a specialized living tissue in vascular plants that is responsible for the transport of organic compounds, particularly the products of photosynthesis, from the leaves to other parts of the plant. It is a vital component of the plant's vascular system, working in conjunction with the xylem to facilitate essential nutrient distribution.
**A** Phloem transports food materials which the plants make.
**B**. It transports materials in all the direction
**The phloem is composed of different cell types, including:**
**A.** Sieve Elements: These are the main conducting cells and are responsible for transporting sugars and other organic nutrients.
**B**. Companion Cells: These cells are closely associated with sieve elements and play a role in supporting their metabolic functions.
**C.** Phloem Parenchyma: These are living cells that provide storage and support to the phloem.

3. **Epidermal cells:** The epidermis of a dicot plant leaf is the outermost layer of cells that serves as a protective barrier, preventing damage caused by sunlight, pathogens, and herbivores. It is typically a single layer of cells and plays a crucial role in gas exchange and transpiration. The epidermal cells are often arranged in a regular pattern and may contain specialized structures such as stomata, which are small pores that allow for the exchange of gases and regulate water loss.
*The epidermis of a dicot plant is the outermost layer of cells that covers the plant's surfaces, such as leaves, stems, and roots. The cells in the epidermis are specialized to perform various functions.*

**Some of the main types of cells found in the epidermis of a dicot plant include**:
**A.** Epidermal cells: These are the most common type of cells in the epidermis. They are tightly packed and provide a protective barrier for the plant.
**B.** Guard cells: These specialized cells are found in the epidermis of leaves and stems. They surround the stomata, which are small openings that allow for gas exchange. Guard cells can open and close the stomata to regulate the exchange of gases and control water loss.
**C.** Trichomes: These are hair-like structures that can be found on the surface of leaves and stems. Trichomes can have various functions, such as reducing water loss, providing protection against herbivores, and reflecting excess sunlight.
**D.** Pavement cells: As mentioned earlier, pavement cells are flat, tightly packed cells that form a continuous layer on the outer surface of leaves. They help reduce water loss and protect underlying tissues.

4. **Guard cells**: These cells control the opening and closing of stomata, regulating gas exchange and water loss. Guard cells are specialized plant cells found in the epidermis of leaves, stems, and other plant organs. They are responsible for controlling the opening and closing of stomatal pores, which play a crucial role in regulating gas exchange, particularly the exchange of carbon dioxide and oxygen during photosynthesis and the release of water vapor during transpiration.

5. **Root hair cells:** *These cells increase the surface area of the roots for better absorption of water and minerals.* Root hair cells are specialized cells found in the epidermis of plant roots. These cells play a crucial role in the absorption of water and nutrients from the soil. They have long, thin projections called root hairs, which greatly increase the surface area available for absorption.

The structure of root hair cells is adapted to their function. The thin, elongated shape of the root hairs allows them to penetrate between soil particles, increasing their contact with water and mineral ions. This enables efficient absorption of water by osmosis and facilitates the uptake of essential nutrients such as nitrates, phosphates, and potassium.

6. **The cambium** is another specialized cell in dicotyledonous plants. It is a meristematic tissue that is responsible for secondary growth, which includes the production of new xylem and phloem cells. The cambium is located between the xylem and phloem in the stem and root, and it allows the plant to increase in girth over time.

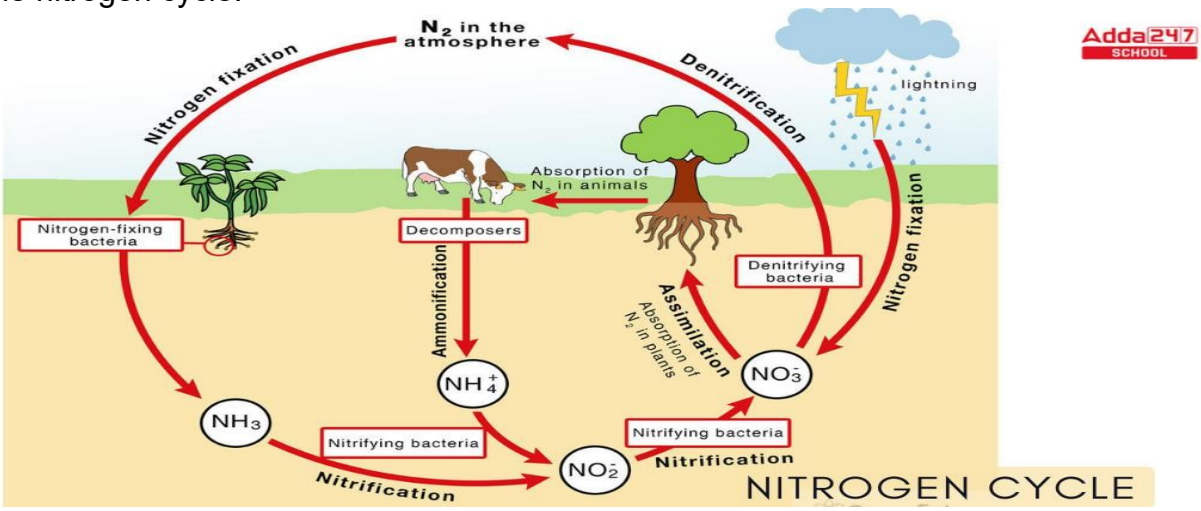
## TEST YOUR MIND

1. This cell sends one way chemical signals throughout the body.
A. Nerve Cell b. Red Blood Cell c. White Blood Cell d. Xylem
2. This specialized cell does not contain a nucleus but allow for transport of oxygen
A. Nerve Cell b. Red Blood Cell c. White Blood Cell d. Palisade cell
3. This plant structure is designed to allow water to move up/out to rest of plant
A. Xylem b. Phloem c. Roots d. Leaves
4. These specialized cells contain a large number of chloroplasts for absorbing light
A. Nerve Cell b. Photosynthetic Cell
c. Smooth Muscle cell d. Chlorophyll
5. These specialized cells contain a large number of chloroplasts. Why might they need that?
A. They need to fill up their cytoplasm. B. They are absorbing the most light for photosynthesis.
C. They are protecting the plant. D. They are getting ready to divide.
6. ____ cells help organisms to move.
A. Ciliated b. Muscle c. Red blood d. Nerve
7. Chloroplasts carry out...
A. Phagocytosis b. Phylocytosis c. Photosynthesis d. Respiration
8.What cell carries the father's genetic information? A. Sperm cell b. Egg cell
c. Leaf cell d. Red blood cell
9. What cells have fine hairs?
A. Ciliated cells b. Root cells c. Mouth cells d. Red blood cells
10. What cells have NO nucleus?
A. Leaf cells b. Animal cells c. Red blood cells D. Egg cells
11. What is another name for a palisade cell?
A. Egg cell b. Sperm Cell c. Leaf cell d. Animal cell
12. Which of these is not a unicellular organism?
A. Amoeba b. Euglena c. Protozoa d. Red blood cells
13. Flagella are used for.. A. Food b. Movement c. Collecting sunlight d. Respiration
14. Mitochondria are used for... A. Collecting sunlight b. Containing genetic material
c. Respiration d. Collecting water
15. The nucleus a. Contains genetic material b. Is for respiration c. Is for photosynthesis d. Is for movement
16. Specialized cells that absorb water by osmosis a. Nerve Cell b. Xylem
c. Palisade Cell d. Root Hair Cell
17. This organelle takes food and turns it into ENERGY for plant and animal cells.
A. Chloroplast b. Mitochondria
c. Lysosome d. Ribosome
18. This cell can swim to find the female egg cell
A. Sperm b. Ciliated cell c. Red blood cell d. Nerve cell
19. Cells with tiny hair like structures on it. It functions to remove dust and bacteria from trachea. A. Sperm b. Palisade
c. Ciliated cell d. Plant cell
20. Organs that work together to perform a related function is called _____?
A. Cells b. Tissues c. Organ system d. Organs

## STRAND 2: CYCLES
## SUB-STRAND 1: EARTH SCIENCE
**B9.2.1.1.1 Explain the process of Nitrogen cycle as a repeated pattern in nature.**

### NITROGEN CYCLE

***What is nitrogen cycle?*** *The nitrogen cycle is a natural process that describes the movement and transformation of nitrogen in various forms through the environment.* It is also the biogeochemical cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial, and marine ecosystems. The conversion of nitrogen cycle can be carried out through both biological and physical processes. The ways through which nitrogen lost from the soil are replaced constitutes the nitrogen cycle.




### Processes or Steps involved in the Nitrogen Cycle

1**. Nitrogen Fixation**: This is the first stage of the nitrogen cycle, *where atmospheric nitrogen (N2) is converted into a usable form by nitrogen-fixing bacteria.* These bacteria, such as **Rhizobium and Azotobacter**, have the ability to convert atmospheric nitrogen into ammonia (NH3) or ammonium ($NH_2^+$).

**Types of Nitrogen Fixation**

A. **Atmospheric fixation:** A natural phenomenon where the energy of lightning breaks the nitrogen into nitrogen oxides and is then used by plants.

B. **Industrial nitrogen fixation:** This is a man-made alternative that aid in nitrogen fixation by the use of ammonia. Ammonia is produced by the direct combination of nitrogen and hydrogen and later converted into various fertilizers such as urea.

C. **Biological nitrogen fixation:** We already know that nitrogen is not usable directly from the air for plants and animals. Bacteria like Rhizobium and blue-green algae transform the unusable form of Nitrogen into other compounds that are more readily usable. These nitrogen compounds get fixed in the soil by these microbes.

2. **Nitrification**: In this stage, *ammonia is converted into nitrite (NO2-) and then into nitrate (NO3-) by nitrifying bacteria.* The first group of bacteria, called **Nitrosomonas,** converts ammonia into nitrite, while the second group, called **Nitrobacter,** converts nitrite into nitrate.

3. **Assimilation:** During assimilation, plants and other organisms take up nitrate from the soil and convert it into organic compounds, such as proteins and nucleic acids. However, it is not bacteria that directly carry out this process. Instead, it is the plants themselves, through their root systems and metabolic processes that assimilate nitrate and incorporate it into their tissues

4. **Ammonification**: *Ammonification is the process of converting organic nitrogen compounds, such as dead plants and animals, into ammonia*. This stage is facilitated by decomposer bacteria, such as **Bacillus and Clostridium**, which break down organic matter and release ammonia.

5. **Denitrification:** *Denitrifying bacteria convert nitrate back into atmospheric nitrogen, completing the nitrogen cycle*. These bacteria, such as **Pseudomonas and Paracoccus,** thrive in oxygen-depleted environments and convert nitrate into nitrogen gas (N2), which is released back into the atmosphere.

**Important reasons why the nitrogen cycle is significant:**
1. It helps in the formation of proteins and DNA.
2. It supports plant growth and development.
3. It contributes to the balance of ecosystems.
4. It aids in the production of nitrate-based fertilizers.
5. It plays a role in the removal of harmful pollutants from the environment.

**Ways in which the nitrogen cycle is important to living organisms**
- Supplies nitrates for plant use.
- Releases locked up nitrogen in living tissues.
- Improves nutrient balance.

**Processes in the nitrogen cycle that add nitrogen to the soil**
- Nitrogen fixation.
- Nitrification. Nitrification is the process that converts ammonia to nitrite and then to nitrate.
- Putrefaction. It is the process of decay and decomposition of organic matter, particularly the breakdown of animal or plant tissue by microorganisms such as bacteria and fungi.
- Thunderstorm or lightening.
- Death or decay of organism.

**Processes in the nitrogen cycle that removes nitrogen from the soil.**
- Denitrification: This is the process that converts nitrate to nitrogen gas, thus removing bioavailable nitrogen and returning it to the atmosphere.
- Nitrate reduction
- Plant growth
- Plant removal or removal of crops.

**Uses of nitrogen to plants.**
- Supports Growth:
- Enhances Leaf Growth:
- Improves Seed and Fruit Development:
- Increases Resistance to Stress:
- Boosts Nutrient Uptake:
- Enhances Crop Yields:

**Forms in which nitrogen is used up or absorbed by plants or organisms**

1. Ammonium 2. Nitrate 3. Nitrogen gas

**How legumes are able to add nitrogen to the soil.**
Legumes have a unique ability to host bacteria called rhizobia in nodules on their roots. Through a symbiotic relationship, these bacteria convert atmospheric nitrogen into a usable form for plants, providing them with essential nitrogen for growth. This process, known as nitrogen fixation, enhances soil fertility as legumes release nitrogen into the soil when they die or shed leaves, benefiting other nearby plants.

**The role of lightning in the nitrogen cycle**.
Lightning plays a brief but crucial role in the nitrogen cycle through a process called atmospheric nitrogen fixation. During thunderstorms, lightning generates intense heat and energy that split atmospheric nitrogen molecules (N2) apart. These individual nitrogen atoms combine with oxygen and other elements in the air, forming nitrogen oxides (NO2). These nitrogen oxides dissolve in rainwater, creating nitric acid (HNO3), which falls to the ground as a component of precipitation.

***How the nitrogen cycle and the environment are closely interconnected.***

The nitrogen cycle and the environment are indeed closely interconnected. The nitrogen cycle is a natural process that involves the conversion of nitrogen from one form to another, and it plays a crucial role in maintaining the balance of nitrogen in the environment.

Nitrogen is an essential element for all living organisms, and it is a key component of proteins, DNA, and other important molecules. However, nitrogen gas (N2) in the atmosphere is not directly usable by most organisms. The nitrogen cycle helps convert atmospheric nitrogen into forms that can be utilized by living organisms.

The cycle begins with nitrogen fixation, where certain bacteria convert atmospheric nitrogen into ammonia (NH3) or nitrate (NO3-) ions. This process can occur through biological nitrogen fixation, where certain bacteria in the soil or in the roots of leguminous plants convert nitrogen gas into ammonia, or through industrial nitrogen fixation, where humans convert nitrogen gas into ammonia through the Haber-Bosch process.

Once ammonia or nitrate is available, it can be taken up by plants and used to build proteins and other nitrogen-containing compounds. This is called assimilation. Animals then obtain nitrogen by consuming plants or other animals.

After organisms die or excrete waste, the nitrogen in their bodies is returned to the environment through decomposition. Decomposers, such as bacteria and fungi, break down organic matter and release ammonia back into the soil. This process is called ammonification.

Ammonia can then be further converted into nitrite (NO2-) and nitrate (NO3-) through nitrification, which is carried out by specific bacteria. Nitrate is the most common form of nitrogen taken up by plants.

Finally, denitrification occurs when certain bacteria convert nitrate back into nitrogen gas, completing the cycle.

The nitrogen cycle has a significant impact on the environment. Excessive nitrogen can lead to environmental issues such as eutrophication, where an excess of nutrients in water bodies can cause excessive algae growth and oxygen depletion. This can harm aquatic ecosystems.

Additionally, nitrogen oxides (nox) released from human activities, such as burning fossil fuels and industrial processes, can contribute to air pollution and the formation of smog.

**The nitrogen cycle is a repeated pattern in nature**

This is because it is essential for the survival of living organisms. Nitrogen is a crucial element for the formation of proteins, DNA, and other important molecules in all living organisms. However, nitrogen gas (N2) in the atmosphere cannot be directly used by most organisms.

The nitrogen cycle involves a series of processes that convert nitrogen from the atmosphere into forms that can be utilized by living organisms. These processes include nitrogen fixation, nitrification, assimilation, ammonification, and denitrification.

During nitrogen fixation, certain bacteria and cyanobacteria convert atmospheric nitrogen into ammonia (NH3) or ammonium ions (NH4+), which can be used by plants. Nitrification is the process by which ammonia is converted into nitrite (NO2-) and then into nitrate (NO3-), which can be taken up by plants.

Plants then assimilate the nitrate ions and incorporate them into their tissues. When animals consume plants, they obtain the nitrogen compounds and use them to build their own proteins and other molecules.

After death or waste excretion, nitrogen is released back into the environment through ammonification, where organic nitrogen is converted into ammonia by decomposers. Finally, denitrification occurs when certain bacteria convert nitrate back into nitrogen gas, completing the cycle.

This cycle is repeated continuously in nature to ensure a constant supply of usable nitrogen for organisms. It allows for the recycling and conservation of nitrogen, preventing it from being lost from ecosystems and maintaining the balance of nutrients in the environment.

**How certain plants such as leguminous crops can replenish (restore) nitrogen in the soil**

Certain leguminous crops have a unique ability to replenish nitrogen in the soil through a process called **nitrogen fixation.** These crops, such as **soybeans, peas, and clover**, form a **symbiotic relationship** with nitrogen-fixing bacteria known as rhizobia. (***A symbiotic relationship*** *is a close and long-term interaction between two different species. It can be beneficial, where both species*

*benefit from the relationship, or it can be parasitic, where one species benefits at the expense of the other.)*
The roots of leguminous plants have specialized structures called nodules, which provide a suitable environment for the rhizobia to live and multiply. The rhizobia bacteria have the ability to convert atmospheric nitrogen gas (N2) into ammonia (NH3) through nitrogen fixation.

Inside the nodules, the legume plants provide the rhizobia with carbohydrates and other nutrients, while the rhizobia provide the plants with fixed nitrogen in the form of ammonia. This fixed nitrogen can be used by the legume plants for their own growth and development.
When the leguminous crops are harvested or die, the nitrogen-rich plant material decomposes, releasing the fixed nitrogen back into the soil. This replenishes the soil with usable nitrogen, making it available for other plants to utilize.

In addition to replenishing nitrogen in the soil, leguminous crops also have the ability to improve soil fertility. The fixed nitrogen they release into the soil can be utilized by other plants in the vicinity, promoting their growth. This is why leguminous crops are often used in crop rotation systems to enhance soil health and reduce the need for synthetic nitrogen fertilizers.

**Activities that can interrupt nitrogen cycle**

**A. Leaching** interrupts the nitrogen cycle by washing away nutrients, including nitrogen, from the soil. When there is excess water, it carries the nitrogen along with it, reducing the availability of nitrogen for plants. This can lead to nutrient deficiencies and hinder plant growth.

**B. Bush burning** interrupts the nitrogen cycle by releasing nitrogen stored in organic matter back into the atmosphere as nitrogen gas. When vegetation is burned, the nitrogen that was previously locked in the plants is released and lost to the atmosphere. This reduces the amount of nitrogen available for plants to use for growth and development.

**C. Destruction of legumes** interrupts the nitrogen cycle by reducing the input of nitrogen into the soil. Legumes are nitrogen-fixing plants, which mean they have a symbiotic relationship with nitrogen-fixing bacteria in their root nodules. These bacteria convert atmospheric nitrogen into a form that plants can use. When legumes are destroyed or removed from an ecosystem, the input of nitrogen into the soil decreases, leading to a decrease in nitrogen availability for other plants. This can result in nutrient deficiencies and impact the overall productivity of the ecosystem.

**What will happen when actions such as leaching, bush burning, and destruction of legumes interrupt the nitrogen cycle**

When actions such as leaching, bush burning, and destruction of legumes interrupt the nitrogen cycle, it can have several consequences

**Leaching** refers to the process of nutrients, including nitrogen, being washed away from the top soil by water. *This can result in a loss of nitrogen from the ecosystem, leading to nutrient depletion and reduced plant growth.*

**Bush burning**; on the other hand, can release large amounts of nitrogen into the atmosphere as nitrogen oxides. *This can contribute to air pollution and can also lead to a decrease in available nitrogen for plants and other organisms.*

**Legumes**, such as beans and peas, have a unique ability to fix atmospheric nitrogen into a form that plants can use. *When legumes are destroyed, this natural nitrogen fixation process is disrupted, resulting in a reduction of available nitrogen in the soil.*
Overall, the interruption of the nitrogen cycle through actions like leaching, bush burning, and destruction of legumes can disrupt the balance of nitrogen in ecosystems, leading to nutrient imbalances, reduced plant growth, and potential environmental issues.

**Eutrophication**
Eutrophication is the process by which a body of water, such as a lake or pond, becomes overly enriched with nutrients, especially phosphorus and nitrogen.

**How does nitrogen cycle contribute to eutrophication?**

The nitrogen cycle contributes to eutrophication by facilitating the overgrowth of algae and aquatic plants due to the excessive presence of nitrogen compounds in water bodies, leading to imbalances in the ecosystem and potentially harming aquatic life.

**Ways the nitrogen cycle can be disrupted:**

1. Excessive use of synthetic fertilizers: Overuse of synthetic fertilizers can lead to an excess of nitrogen in the soil, disrupting the natural balance of the nitrogen cycle.
2. Deforestation: Clearing forests can disrupt the nitrogen cycle by removing nitrogen-fixing plants and reducing the amount of organic matter that decomposes and releases nitrogen back into the soil.
3. Pollution: Industrial and agricultural pollution can introduce excessive amounts of nitrogen into water bodies, leading to eutrophication and disrupting the nitrogen cycle in aquatic ecosystems.
4. Urbanization: Urban development can lead to the destruction of natural habitats and the loss of nitrogen-fixing plants, disrupting the nitrogen cycle in those areas.
5. Overfishing: Overfishing can disrupt the nitrogen cycle in marine ecosystems by removing top predators that play a role in recycling nitrogen through their excretion.
6. Climate change: Changes in temperature and precipitation patterns caused by climate change can affect the rates of nitrogen fixation, nitrification, and denitrification, disrupting the nitrogen cycle.

**The effects of nitrogen cycle disruption:**

1. Altered plant growth: Excessive nitrogen can lead to an overgrowth of certain plant species, which can outcompete other plants and disrupt the natural balance of plant communities.
2. Reduced biodiversity: Changes in nitrogen availability can favor certain species over others, leading to a loss of biodiversity in ecosystems.
3. Water pollution: Excess nitrogen can leach into water bodies, leading to eutrophication, which can cause algal blooms, oxygen depletion, and harm aquatic organisms.
4. Air pollution: Nitrogen compounds released into the atmosphere can contribute to air pollution, including the formation of smog and acid rain.
5. Negative impacts on human health: Nitrogen pollution in water and air can have adverse effects on human health, such as respiratory problems and increased risk of certain diseases.
6. Disrupted food webs: Changes in nitrogen availability can affect the abundance and distribution of organisms at different trophic levels, potentially disrupting food webs and ecological interactions.

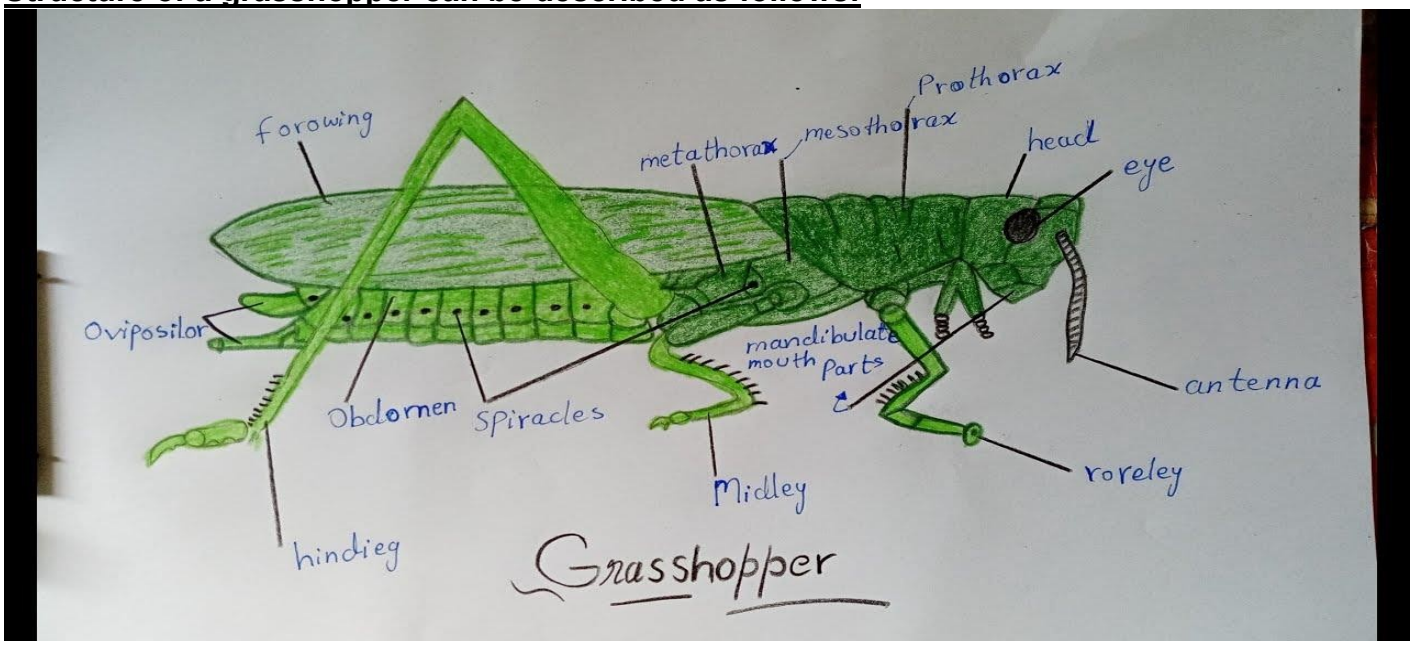
**Test your mind**

1. Which of the following statements is correct?
   a. Atmosphere is the major reservoir for plants
   b. Nitrogen is the most abundant nutrient for plants
   c. Nitrogen cycle is a sedimentary cycle
   d. All
2. Nitrogen is absorbed by the plants in the form of
   a. Ammonium
   b. Nitrites
   c. Nitrates
   d. All
3. Nitrogen fixation is the conversion of
   a. $N_2$ to N
   b. $N_2$ to $NH_3$
   c. $N_2$ to $NO_3^-$
   d. $N_2$ to urea
4. Important enzymes involved in nitrogen fixation are
   a. Nitrogenize and hydrogenate
   b. Nitrogenase and hexokinase
   c. Nitrogenase and peptidase
   d. Nitrogenase and hydrolyase
6. Ammonification is the formation of
   a. Ammonia from nitrates by decomposers
   b. Ammonia from nitrogen
   c. Ammonia from amino acids
   d. Ammonia from nitrates by nitrogen fixers

## STRAND 2: CYCLES
## SUB-STRAND 2: LIFE CYCLE OF ORGANISMS
### *B9.2.2.1.1 Describe the life cycle of grasshopper which depicts incomplete metamorphosis*

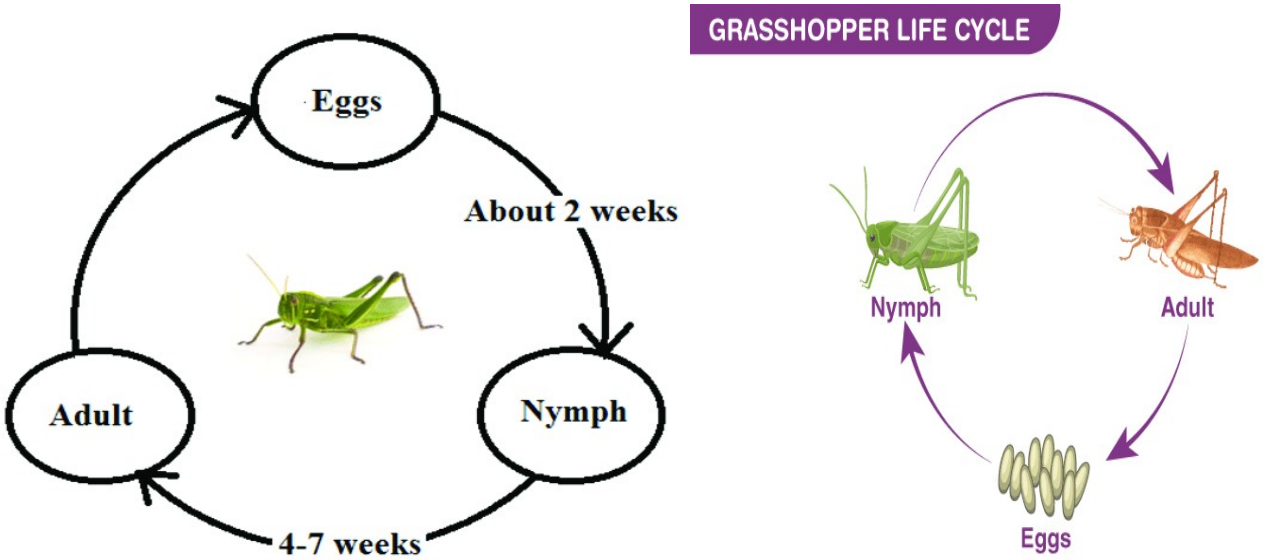
**A grasshopper** is an insect that belongs to the order **Orthoptera.** They are known for their ability to jump long distances using their powerful hind legs. Grasshoppers have a slender body with two pairs of wings, with the front wings being thickened and leathery, while the hind wings are transparent and used for flying. They also have large compound eyes and long antennae. Grasshoppers are herbivorous and feed on plants, primarily consuming leaves and grasses. Grasshoppers can be found in various habitats around the world, including ***grasslands, meadows, forests, and even urban areas***.
They are most commonly found in areas with abundant vegetation, as they rely on plants for food and shelter. Some species of grasshoppers are more adapted to specific environments, such as desert grasshoppers found in arid regions. Overall, grasshoppers can be found in many different locations, depending on the species and their specific habitat requirements.

**Structure of a grasshopper can be described as follows:**




1. Body: Grasshoppers have three main body parts - the head, thorax, and abdomen.
2. Head: The head of a grasshopper contains the sensory organs, including the compound eyes, antennae, and mouthparts. The compound eyes provide excellent vision, while the antennae are used for sensing the environment.
3. Thorax: The thorax is the middle part of the grasshopper's body and is divided into three segments. Each segment has a pair of jointed legs, which are used for walking and jumping. The hind legs are particularly strong and adapted for jumping.
4. Wings: Grasshoppers have two pairs of wings. The front pair, called tegmina, are thick and leathery and provide protection for the hind wings. The hind wings are large and membranous, allowing the grasshopper to fly.
5. Abdomen: The abdomen is the rear part of the grasshopper's body and contains the digestive and reproductive organs**. Spiracles** are the openings on the sides of an insect's body through which they breathe. Grasshoppers have spiracles located along the sides of their abdomen. These spiracles allow them to take in oxygen and release carbon dioxide.

**The life cycle of a grasshopper**
Unlike complete metamorphosis seen in insects like butterflies, grasshoppers do not have a distinct pupal stage. Instead, they gradually develop into adults through a series of moult
The life cycle of a grasshopper consists of three main stages: egg, nymph, and adult.




**1. Egg:** *Female grasshoppers lay their eggs in the* ***soil*** or on plant stems during the fall or winter. The eggs are usually protected by a foamy substance called an egg pod. They remain dormant throughout the winter and hatch in the spring. After mating, female grasshoppers lay their eggs in the soil, and excrete sticky foam like substances that covers the .this form a hard cover around the egg.

**2. Nymph:** When the eggs hatch, young grasshoppers called nymphs emerge. Nymphs look similar to adult grasshoppers but are smaller and lack wings. ***They go through a series of molts, shedding their exoskeletons as they grow***. With each molt, they become larger and develop more adult-like features. Nymphs continue to feed on plants and grow until they reach adulthood.

***Moulting*** *is a process where they shed their exoskeleton in order to grow.*
As grasshoppers grow, their exoskeleton becomes too small and rigid, limiting their ability to move and grow further. To overcome this, grasshoppers undergo molting. During molting, the grasshopper secretes a hormone that triggers the shedding of the old exoskeleton. The grasshopper then expands its body and a new, larger exoskeleton forms underneath. Once the new exoskeleton hardens, the grasshopper is able to resume its normal activities. Molting is a crucial process for grasshoppers to continue growing and developing throughout their life cycle.

**3. Adult:** Once the nymphs have completed their final molt, they become adult grasshoppers. Adult grasshoppers have fully developed wings and reproductive organs. They are capable of flight and mating. The lifespan of an adult grasshopper can vary depending on the species, but it is typically several weeks to a few months.

**Metamorphosis** is a biological process in which an organism undergoes distinct changes in its body structure and form during its life cycles.
**There are two main types of metamorphosis**:
A. Incomplete metamorphosis b. Complete metamorphosis.

**Incomplete metamorphosis** is a type of development seen in insects like grasshoppers and dragonflies. In this process, the insect goes through three stages: egg, nymph, and adult. The nymph resembles the adult but lacks wings and reproductive organs. As it grows, it molts several times until it reaches its final adult form. Organisms that undergo incomplete metamorphosis include: Grasshoppers, Crickets, Dragonflies, Damselflies, Cockroaches, Praying mantises, Termites and Mayflies.

**Complete metamorphosis**, on the other hand, is a more complex process observed in insects like butterflies, moths, and beetles. It involves four distinct stages: egg, larva (caterpillar or grub), pupa

(chrysalis or cocoon), and adult. The larva looks completely different from the adult and goes through a period of transformation inside the pupa before emerging as an adult. Organisms that undergo complete metamorphosis include: Butterflies, Moths, Beetles, Flies, Bees, Wasps, Ants and Mosquitoes.

**The life cycle of a grasshopper is described as incomplete metamorphosis**

This is because it goes through three distinct stages: egg, nymph, and adult. Unlike insects with complete metamorphosis, such as butterflies, grasshoppers do not have a pupal stage. Instead, the nymphs resemble miniature versions of the adult grasshoppers and go through a series of molts to grow and develop.

**Benefit of the activities of grasshopper to farmers**

1. They feed on poisonous weeds that can harm livestock
2. They improve soil fertility through droppings
3. They eat weeds that compete with crops for nutrient
4. They prevent overgrowth of plants
5. Grasshoppers can inadvertently aid in the pollination of plants as they move from flower to flower in search of food

**The negative effects of grasshoppers on farmers include:**

1. Crop damage: Grasshoppers are known to feed on various crops, including grains, vegetables, and fruits. When present in large numbers, they can consume significant amounts of plant material, leading to reduced crop yields and financial losses for farmers.
2. Economic impact: Crop damage caused by grasshoppers can result in financial hardships for farmers, especially those who rely on their crops for income. The cost of controlling grasshopper populations and repairing the damage they cause can also add to the economic burden.
3. Increased pesticide use: To protect their crops from grasshopper damage, farmers may resort to using pesticides. While effective in controlling grasshoppers, excessive pesticide use can have negative environmental impacts and may harm beneficial insects and other organisms.
4. Competition for resources: Grasshoppers compete with livestock and wildlife for available vegetation. In areas where grasshopper populations are high, they can deplete food sources for livestock, leading to reduced grazing opportunities and potential impacts on animal health.

**To increase the activities of grasshoppers, you can consider the following activities:**

1. Providing suitable habitat: Creating grassy areas with plenty of vegetation and food sources can attract grasshoppers.
2. Avoiding the use of insecticides: By refraining from using insecticides, you allow grasshoppers to thrive without any interference.
3. Planting preferred food sources: Growing plants that grasshoppers prefer to feed on, such as grasses and certain vegetables, can attract them to your garden.
4. Providing water sources: Grasshoppers need water to survive, so having accessible water sources like ponds or shallow dishes can encourage their activities.
5. Avoiding predators: Minimizing the presence of natural predators like birds or frogs can help grasshoppers feel safer and more active.

**To reduce the activities of grasshoppers, there are a few activities that can be promoted:**

1. Implementing proper garden maintenance: Regularly mowing the lawn, removing weeds, and keeping the garden area clean can help reduce the habitat and food sources for grasshoppers.
2. Using physical barriers: Installing fences or netting around vulnerable plants or garden areas can prevent grasshoppers from accessing them.
3. Introducing natural predators: Encouraging the presence of natural predators like birds, frogs, or beneficial insects can help control grasshopper populations.

4. Applying organic insecticides: Using organic insecticides made from natural ingredients like neem oil or garlic spray can help deter grasshoppers from feeding on plants.
5. Crop rotation: Rotating crops in the garden can disrupt grasshopper breeding cycles and reduce their population

**The different methods of controlling grasshoppers.**

**Physical methods** of grasshopper control involve physically removing or preventing grasshoppers from causing damage. This can include measures like handpicking or vacuuming grasshoppers, using barriers or nets to protect plants, or creating physical barriers to prevent grasshoppers from entering an area.

**Chemical** methods of grasshopper control involve using insecticides to kill grasshoppers. This can be done through spraying insecticides directly on the grasshoppers or treating plants with insecticides to deter them from feeding.

**Biological methods** of grasshopper control involve using natural predators or pathogens to control grasshopper populations. For example, introducing predatory insects or birds that feed on grasshoppers can help reduce their numbers.

**Environmental** methods of grasshopper control involve modifying the environment to make it less suitable for grasshoppers to breed or survive. This can include practices like crop rotation, maintaining healthy soil, or using proper irrigation techniques to discourage grasshopper populations.

**Integrated Pest Management** (IPM) is a comprehensive approach that combines multiple methods of grasshopper control. It involves assessing the specific grasshopper problem, implementing a combination of physical, chemical, biological, and environmental control methods, and monitoring the effectiveness of these measures over time.

**Test your mind**

1. The eggs of a grasshopper are laid in _____
A. Water b. Soil c.tree
2. How many stages does an incomplete life cycle have?
A. 1 b.2 c. 3 d.4
3. What do we call the process of shedding of outgrown skins several times?
A. Moulting b. Hatching c. Skinning
4. What do we call the young grasshopper?
A. Egg b. Pupa c. Larva d. Nymph
True or False: An adult grasshopper has wings and it can fly
A. True b. False
5. In the NYMPH stage, the organisms job is _____
A. To reproduce b. To eat c. To hatch
6. Which is TRUE?
A. After moulting, the insect grows bigger.
B. The nymph does not look like the adult.
C. Both the nymph and the adult have wings.
7. What is the similarities the life cycle of cockroach and grasshopper?
A. They have hair
B. Their egg laid in the water
C. They both have three stages of life cycle
8. What do we call the second stage the life cycle of a grasshopper?
A. Young b. Adult c. Nymph
9. What stage the adult female grasshopper is ready to lay eggs?
A. Adult b. Nymph c. Egg

## STRAND 2: CYCLES
## SUB-STRAND 3: CROP PRODUCTION

**B9.2.3.1.1 Observe and describe differences in maturities of crops grown in different soil medium and different seed beds.**

**Crop maturity** refers to the stage in the growth and development of a crop when it has reached its optimal physiological and physical state for harvest.
**Maturation** is indicative of the fruit or crop being ready for harvest

The maturity stages of different crops can vary depending on the soil media and seed beds used. Each crop has its own specific growth and development timeline, and the soil medium and seed bed can influence this process. For example, in a soil medium that is rich in nutrients and has good moisture retention and drainage, crops may experience faster growth and reach maturity earlier. On the other hand, in a soil medium that lacks nutrients or has poor moisture retention and drainage, crops may take longer to mature.

Similarly, the type of seed bed used can also affect the maturity stages of crops. Well-prepared seed beds with good soil structure can promote better seed germination and root establishment, leading to faster growth and maturity. Conversely, seed beds with poor soil structure or inadequate preparation may delay seed germination and hinder root development, resulting in slower crop maturity.

It's important to consider that different crops have different growth requirements and maturity timelines. Some crops may naturally take longer to mature regardless of the soil medium and seed bed used. Additionally, other factors such as **climate, irrigation, and crop management practices can also influence the maturity stages of crops.**

**Stages in the life cycle of a flowering plant.**

- Germination
- Seedling
- Mature plant
- Flowering
- Pollination
- Fertilization
- Formation of seeds and fruits
- Dispersal of seeds and fruits

**Classification crops according to their length of their grow period**

**1. Annual crops**, also known as arable crops, are crops that are planted and harvested within a single growing season. Some examples of annual crops or arable crops include corn, wheat, rice, soybeans, barley, oats, potatoes, tomatoes, carrots, lettuce, and many more.
**2. Biennial crops** are crops that have a two-five years life cycle. In the first year, biennial crops typically grow vegetatively, developing roots, stems, and leaves. In the second year, they produce flowers, fruits, or seeds before completing their life cycle. Some examples of biennial crops include carrots, beets, onions, parsley, pepper and yam.
**3. Perennial crops** are crops that have a longer lifespan and can produce harvests for multiple years. Unlike annual crops, which complete their life cycle within one year, perennial crops continue to grow and produce crops for several years. Examples of perennial crops include fruit trees like apple, pear, and cherry trees, as well as perennial vegetables like asparagus and rhubarb.

**The principles of crop production**

The principles of crop production involve various factors and practices that contribute to successful crop growth and yield. Some key principles include:
**1. Climatic condition 2. Site selection. 3. Crop selection 5. Time of planting**

**6. Cultural practices** **7. Harvesting** **8. Storage** **9. Marketing**

**Methods of sowing seeds on a Raised bed.**

- **Broadcasting:** This is the scattering seeds at random and uniformly over the soil surface.
- **Drilling:** This is creating shallow trenches or drilling and spreading seeds in them.
- **Planting at stake or seed hole:** This is when a stick or cutlass is used to bore hole in the ground and the seeds is put in the soil

***B9.2.3.2.1 Observe and record the uses of different crops a different maturity stages.***

**Maize cultivation in the school garden**

The stages involved in maize cultivation typically include:
1. Land preparation: This involves clearing the land of any weeds or debris and preparing the soil for planting.
2. Seed selection: Choosing high-quality maize seeds that are suitable for the specific growing conditions and desired yield.
3. Planting: Sowing the maize seeds in rows or hills, usually at a depth of about 1-2 inches.
4. Germination: The seeds sprout and begin to grow, usually within 7-10 days after planting.
5. Vegetative stage: The maize plants develop leaves and stems, growing taller and establishing a strong root system.
6. Tasseling: The tassel, which contains the male flowers, emerges at the top of the plant.
7. Silking: The silks, which are the female flowers, emerge from the ear of the maize plant.
8. Pollination: The pollen from the tassel is transferred to the silks, fertilizing the ovules and leading to kernel development.
9. Ear development: The ears of maize start to grow and fill out with kernels.
10. Grain filling: The kernels continue to develop and fill with starch, proteins, and other nutrients.
11. Maturation: The maize plants reach full maturity, and the kernels become dry and hard.
12. Harvesting: The mature maize plants are harvested by cutting the stalks and collecting the ears.

**The stages involved in tomato cultivation typically include the following:**

1. Seed selection and preparation: This involves choosing high-quality tomato seeds and preparing them for planting.
2. Seed sowing: The seeds are sown in a suitable growing medium, such as seed trays or pots, and kept in a warm and well-lit area for germination.
3. Seedling care: Once the seeds have germinated, the seedlings need to be cared for by providing adequate water, light, and nutrients.
4. Transplanting: When the seedlings have grown to a certain size, they are transplanted into larger containers or directly into the ground.
5. Plant care: This stage involves regular watering, fertilizing, and pruning to ensure healthy growth and development of the tomato plants.
6. Flowering and fruiting: Tomato plants produce flowers, which then develop into fruits. This stage requires proper pollination and favorable environmental conditions.
7. Harvesting: Once the tomatoes have ripened, they can be harvested by gently picking them from the plants.

**The stages involved in carrot cultivation typically include the following:**

1. Seed selection and preparation: This involves choosing high-quality carrot seeds and preparing them for planting.
2. Seed sowing: The seeds are sown directly into the ground or in containers filled with well-draining soil.
3. Germination and seedling care: After sowing, the seeds germinate and the seedlings require proper watering, light, and nutrients to ensure healthy growth.

4. Thinning: Once the seedlings have grown a few inches tall, they need to be thinned out to provide enough space for each carrot plant to develop properly.
5. Weed control: Regular weeding is necessary to prevent weeds from competing with the carrot plants for nutrients and sunlight.
6. Watering and fertilizing: Carrot plants require consistent moisture and periodic fertilization to support their growth.
7. Harvesting: Carrots are typically ready for harvest when their roots have reached a desirable size. They can be gently pulled out of the ground or dug up using a garden fork.

**The stages involved in legumes cultivation typically include:**
1. Land preparation: This involves clearing the land of any weeds or debris and preparing the soil for planting.
2. Seed selection: Choosing the right variety of legume seeds is important for a successful crop. Factors such as climate, soil type, and intended use should be considered.
3. Planting: Legume seeds are sown in the prepared soil, either by hand or using machinery, at the appropriate depth and spacing.
4. Germination: After planting, the seeds will absorb water and begin to sprout, leading to the emergence of seedlings.
5. Growth and development: The legume plants will continue to grow, developing leaves, stems, and roots. They will also start to produce flowers.
6. Flowering and pollination: Legume plants produce flowers, which need to be pollinated by insects or wind to form pods.
7. Pod formation: Once pollination occurs, the flowers will develop into pods, which contain the legume seeds.
8. Maturation: The pods will continue to grow and mature, changing in color and texture.
9. Harvesting: Legume crops are harvested when the pods are fully mature. This can be done by hand or using machinery, depending on the scale of cultivation.
10. Post-harvest processing: After harvesting, the legume pods are typically dried and the seeds are separated from the pods. They may also undergo cleaning and sorting processes.

| Crop | Maturity |
|---|---|
| Tomatoes | 10 – 14 weeks |
| Okro | 8 -10 weeks |
| Lettuce | 6 – 12 weeks |
| Carrot | 10 – 12 weeks |
| Maize | 3 – 4 months (90 – 120 days) |
| Rice | 4 - 5 months (130 – 150 days) |
| Groundnut | 3½-5 months |
| Cassava | 6 months – two years |
| Yam | 6 – 12 months |

***B9.2.3.2.2 Evaluate the importance of knowledge of maturity stages of different crops to human beings***

**Importance of knowledge of maturity stages of different crops to humans:**
1. Helps in determining the optimal time for harvesting.
2. Enables proper planning and scheduling of farming activities.
3. Facilitates efficient utilization of resources.
4. Enhances crop quality and yield.
5. Supports effective pest and disease management.

**Cultural practices in crop production**

This refers to all the activities carried out by a farmer between planting and harvesting of a crop.

**Cultural practices in crop & vegetable production**

**1. Thinning out.** This is the process in which excess seedlings are removed from a stand of a seed bed.

**Importance of thinning out**

- To reduce overcrowding of seedlings in order to obtain appropriate population densities.
- To promote healthy growth and development of seedlings.
- To reduce or eliminate competition for light and nutrients among seedlings.
- To remove weak, diseased or dead seedlings.
- To facilitate better weed control.
- To control pests and diseases.

**2. Pricking out.** This is the transfer of seedlings into a larger box (prick out box) or onto a larger bed few days after germination.

**Importance of pricking out**

- To reduce the incidence of pests and diseases.
- To avoid overcrowding of seedlings.
- Improves light penetration.
- Reduces competition for water and nutrients.
- Facilitation of growth of seedlings.
- Improvement in aeration among seedlings.

**3. Mulching.** This is the covering of the surface of a soil with materials such as leaves, manure, dry grass, sawdust, wood shavings, old compost, corn cobs and polythene sheets.

**Ways in which mulching is important in crop production**

- Helps cool the soil or controls soil temperature.
- Helps reduce soil erosion.
- Improves soil structure or compatibility.
- Adds humus to the soil when organic material is used.
- Helps in conserving soil water or keeps the soil moist.

**5. Hardening off.** It is the gradual exposure of seedlings to sunlight and higher temperatures, few days before they are transplanted.

**Importance of hardening off**

- To enable the seedlings, withstand the transplanting shock or harsh condition on the field.

**6. Shading** This is the raising of shelter or shade over seedlings to protect them from too much sunshine and rain. This is commonly done on nursery beds.

**7. Watering** Water is needed for both germination and proper growth of seedlings. It is the most important activity carried out in the nursery, especially during dry season.

7. **Staking** It is the provision of any form of artificial support for plants which have weak stems (and therefore require some support). Plants which have climbing habit of growth at times need to be supported on stakes.
   - Crops that require staking are**:** yam, French bean or lima beans, tomato, cucumber.

8. **Supplying (filling in)** It is the planting of seeds at the stands where seeds fail to germinate or replacement of ungerminated seed at a stand.

9. **Pruning** is the removal of excess or diseased or unwanted parts of the plant.

10. **Training** is the method of getting plants to conform to desired shapes or growth pattern.

11. **Fertilizer/manure application** This refers to any substance either organic or inorganic applied to the soil to supply plant food.

12. **Weed control** This is the process of removing unwanted plants from the farm or garden. It could be done by handpicking, slashing, hoeing and spraying the weed with the appropriate chemicals.

13. **Disease control** This is the act of controlling diseases on the crops. There are two (2) kinds of disease-causing organisms.

A. **Pathogenic diseases:** They are caused by living organisms. They are bacteria, fungi and virus. Bacteria enter crops and feed on their tissues.

B. **Non-pathogenic diseases**: They are causes are brought about by non-living factors. This may include:

- Lack of light or excess light.
- Low environmental temperatures.
- Nutrient deficiencies.

**Reasons or Advantages of planting crops in rows.**

- Encourages use of farm machines.
- Increases plant population per acre.
- Easy to replace dead or diseased crops.

**Farm records**

*These are written documents showing the major activities going in the farming business.*

**Types of farm record**

**1. Production records:** These records document the farm's production activities, such as crop yields, livestock numbers, breeding and calving records, and other production-related data. They help farmers monitor productivity, identify trends, and make informed decisions about their operations.

**2. Inventory records:** These records track the farm's inventory of inputs, such as seeds, fertilizers, pesticides, and equipment, as well as outputs, such as harvested crops or livestock. They help farmers manage their inventory levels, plan for future needs, and ensure efficient use of resources.

**3. The cashbook receipt and payment record** The cashbook is a financial record that tracks all cash transactions made by a business. It includes details of both receipts (money coming in) and payments (money going out). The cashbook helps businesses keep track of their cash flow and ensures accurate financial reporting

**4. An annual valuation record** is a financial document that provides an overview of a company's assets and their estimated value at the end of a fiscal year.

**5. A farm diary** is a record-keeping tool used by farmers to document daily activities and observations on their farm. It helps farmers keep track of tasks, such as planting, harvesting, and animal care, as well as record important information like weather conditions, crop yields, and livestock health.

**6. Farm inventory record** is a document that lists and tracks all the assets and resources on a farm. It includes details of items such as livestock, machinery, equipment, crops, and supplies.

**7. A profit and loss account,** also known as an income statement or statement of earnings, is a financial statement that shows the revenues, expenses, and resulting profit or loss of a business over a specific period of time, usually a fiscal year. It provides a summary of the company's financial performance and helps assess its profitability

**Reason for keeping farm record.**

1. Keeping farm records helps farmers keep track of their finances.
2. Farm records allow farmers to evaluate how well their farm is doing.
3. Farm records help farmers plan and make decisions for their farm.
4. Farm records make sure farmers know the weakness in the farming business.
5. Farm records help farmers manage risks on their farm.

## STRAND 2: CYCLES

## SUB-STRAND 4: ANIMAL PRODUCTION

**B9.2.4.1.1List the ingredients and the method of preparation of different feed for different domestic and commercial animals.**

### Animal feed

**Feed ingredients** are the individual components used to formulate animal feeds, providing essential nutrients for the growth, maintenance, and productivity of livestock.

These ingredients can include:

1. Grains: such as corn, wheat, barley, and oats, serving as a source of carbohydrates and energy.

2. Protein sources: including soybean meal, canola meal, and fish meal, supplying essential amino acids for animal growth and development.

3. Forage: consisting of hay, silage, and pasture grasses for fiber and roughage to support digestive health.

4. Fats and oils: like soybean oil and animal fats, providing concentrated energy for livestock diets.

5. Minerals and vitamins: essential micronutrients added to ensure animals receive all necessary minerals and vitamins for optimal health.

6. By-products: such as distillers' grains from ethanol production or wheat middlings, offering alternative nutrient sources in feed formulations.

7. Additives: including enzymes, probiotics, and prebiotics aimed at improving feed efficiency and animal health.

**Four basic steps to producing animal food**

1. **Receive raw ingredients**
   Feed mills receive raw ingredients from suppliers. Upon arrival, the ingredients are weighed, tested and analyzed for various nutrients and to ensure their quality and safety.

2. **Create a formula**
   Nutritionists work side-by-side with scientists to formulate nutritionally sound and balanced diets for livestock, poultry, aquaculture and pets. This is a complex process, as every species has different nutritional requirements.

3. **Mix ingredients**
   Once the formula is determined, the mill mixes the ingredients to create a finished product.

4. **Package and label**
   Manufacturers determine the best way to ship the product. If it is prepared for retail, it will be —bagged and tagged,ll or placed into a bag with a label that includes the product‘s purpose, ingredients and instructions. If the product is prepared for commercial use, it will be shipped in bulk.

**Ingredients**

There are more than 900 safe agricultural ingredients and crop products approved for use in animal food, including:

- Corn
- Soybean meal
- Dried and wet distillers‘ grains
- Bakery meal
- Corn gluten feed
- Cottonseed meal
- Wheat midds
- Grain sorghum
- Soybean hulls
- Oats
- Amino acids
- Vitamins
- Minerals
- Probiotics
- Enzymes
- Animal protein products
- Fats and oils
- Marine products
- Milk products
- Wheat products
- Flavors

. Wheat bran.

**Comprehensive list of methods used to prepare animal feed:**

1. Mixing
2. Grinding
3. Pelleting
4. Extrusion
5. Fermentation
6. Soaking
7. Flaking
8. Pressure cooking
9. Reconstitution:
10. Gelatinization:
11. Dry rolling
12. Popping:
13. Micronizing:

**1. Mixing:** This method involves combining different ingredients to create a balanced feed. For example, mixing grains, protein sources, vitamins, and minerals to create a complete feed for poultry.

**2. Grinding:** Grinding involves reducing the size of feed ingredients to improve digestibility. For example, grinding corn kernels into a fine powder to make it easier for animals to consume and digest.

**3. Pelleting:** Pelleting involves compressing feed ingredients into pellets using a pellet mill. This method improves feed efficiency and reduces wastage. For example, pelleting a mixture of grains and protein sources to create pelleted feed for cattle.

**4. Extrusion:** Extrusion involves subjecting feed ingredients to high temperature and pressure to create a dense and uniform feed. This method improves digestibility and nutrient availability. For example, extruding a mixture of fishmeal, grains, and oils to create extruded feed for fish.

**5. Fermentation:** Fermentation involves the breakdown of feed ingredients by microorganisms, which improves digestibility and nutrient availability. For example, fermenting silage made from corn or grass to create fermented feed for ruminant animals.

**6. Soaking:** Soaking involves immersing feed ingredients in water to soften them and improve palatability. For example, soaking hay or pellets in water to create soaked feed for horses with dental issues.

**7. Flaking**: Flaking involves flattening feed ingredients to increase surface area and improve digestibility. For example, flaking oats or barley to create flaked feed for horses or poultry.

**8. Pressure cooking**: Pressure cooking involves cooking feed ingredients under high pressure and temperature to improve digestibility and kill harmful bacteria. For example, pressure cooking soybeans to create cooked soybean meal for pigs or poultry.

**9. Reconstitution:** Reconstitution involves adding water to dehydrated feed ingredients to restore their original moisture content. For example, reconstituting dehydrated alfalfa pellets by adding water to create moist feed for rabbits.

**10. Gelatinization:** Gelatinization involves heating feed ingredients in the presence of water to break down starches and improve digestibility. For example, gelatinizing cornmeal to create gelatinized feed for fish or poultry.

**11. Dry rolling:** Dry rolling involves flattening feed ingredients without the addition of water.

**12. Popping**: Popping is a process where heat is applied to a material, such as popcorn kernels, causing them to burst and create a light and fluffy texture.

**13. Micronizing:** Micronizing is a method used to reduce the particle size of a material to a very fine level, typically in the micron range. This process is commonly used in the pharmaceutical or chemical industries.

**The types of nutrition in domestic animals are as follows:**

**1. Herbivorous Nutrition:** This type of nutrition involves animals that primarily consume plant-based food. They have specialized digestive systems to break down cellulose and extract nutrients from plants.

**2. Carnivorous Nutrition:** Carnivorous animals primarily consume animal-based food. Their digestive systems are adapted to process and derive nutrients from animal tissues.

**3. Omnivorous Nutrition:** Omnivorous animals have a diet that includes both plant-based and animal-based food. Their digestive systems are versatile and can process a wide range of food types.

**4. Granivorous Nutrition**: Granivorous animals primarily consume grains and seeds as their main source of nutrition.

**5.Frugivorous Nutrition:** Frugivorous animals primarily consume fruits as their main source of nutrition

**Different type of feed given to farm animal.**

**Hay:** Dried grasses, legumes, or other plants used as feed for livestock, typically harvested and stored for use during non-growing seasons.

**Silage:** Fermented and high-moisture forage stored in airtight conditions, often made from grass, corn, or other crops, providing preserved feed for livestock.

**Grain:** Seeds of cereal crops such as corn, wheat, or oats, commonly used as a concentrated energy source in animal feed.

**Pasture:** Grazed forage consisting of a variety of grasses and plants grown in a designated area for livestock to feed on.

**Concentrates:** Nutrient-dense feed containing higher levels of carbohydrates and proteins, often including ingredients like soybean meal, corn, and barley.

**Forage:** Diverse mixtures of plants and grasses that serve as the primary source of nutrition for grazing animals.

**Minerals and supplements:** Specific mineral mixes or nutritional additives provided to ensure animals receive essential vitamins and minerals not adequately supplied by other feeds

**TEST YOUR MIND**

1. Which type of feed gives a nutritional boost to a ration? A. Concentrate b. Roughage d. Supplement

2. The following are all examples of feed for certain reasons or life stages, except for:
A. Growth b. Reproduction c. Lactation d. Intelligence

3. Which is not a material that provides nutrients?
A. Fats b. Vitamins c. Water d. Air

3. What type of feed has more than 18% crude fiber?
A. Concentrate b. Roughage
C. Supplement

4, The major source of fats and oils in animal feeds are: a. Grains & protein concentrates b. Manure & urine c. Petroleum products d. Vitamins & minerals

5. What is added to feed to improve the palatability and reduce dust? A. Blood meal b. Hay c. Molasses d. Ure

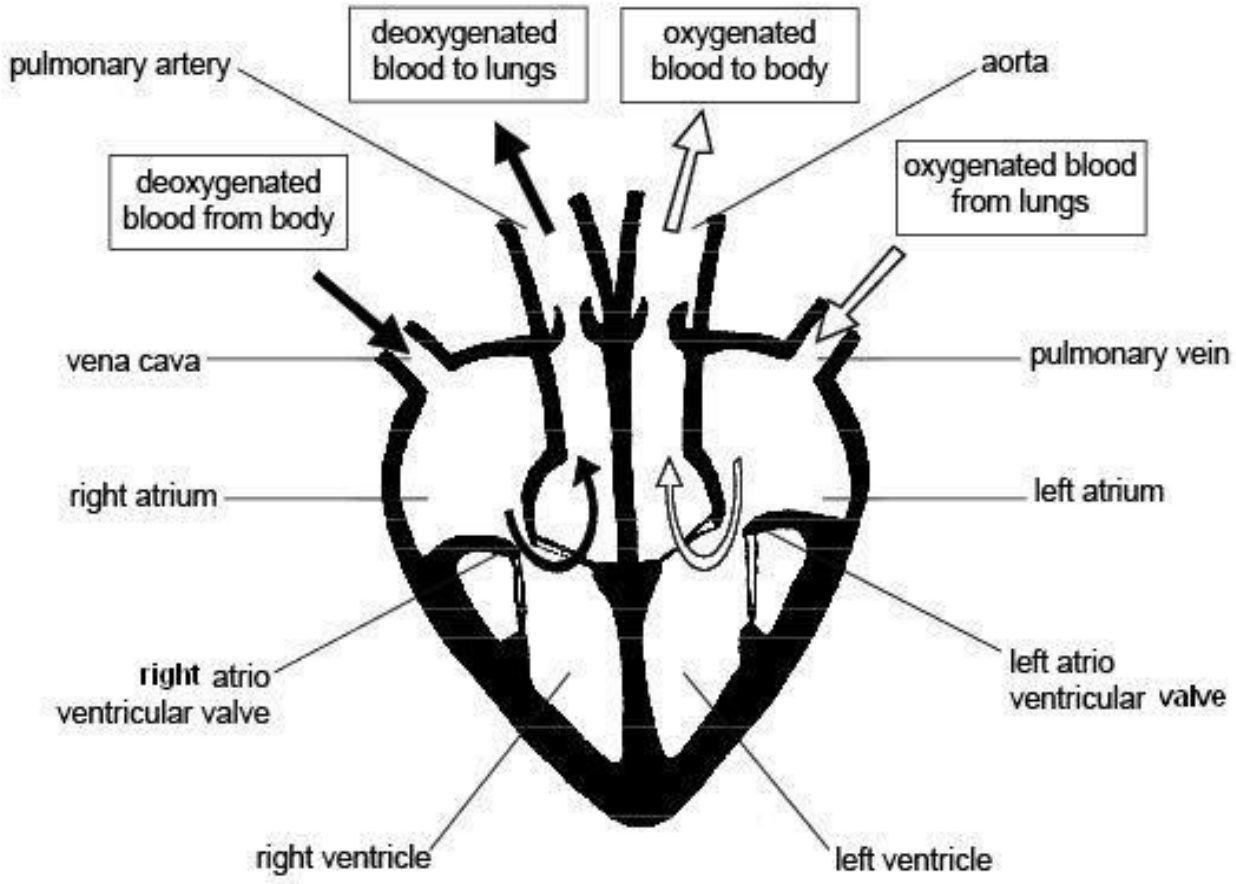
## STRAND 3: SYSTEMS
## SUB-STRAND 1: THE HUMAN BODY SYSTEM
***B9.3.1.1.1 Explain the concept of the circulatory system, state the function of each part of the system and health challenges associated with it***

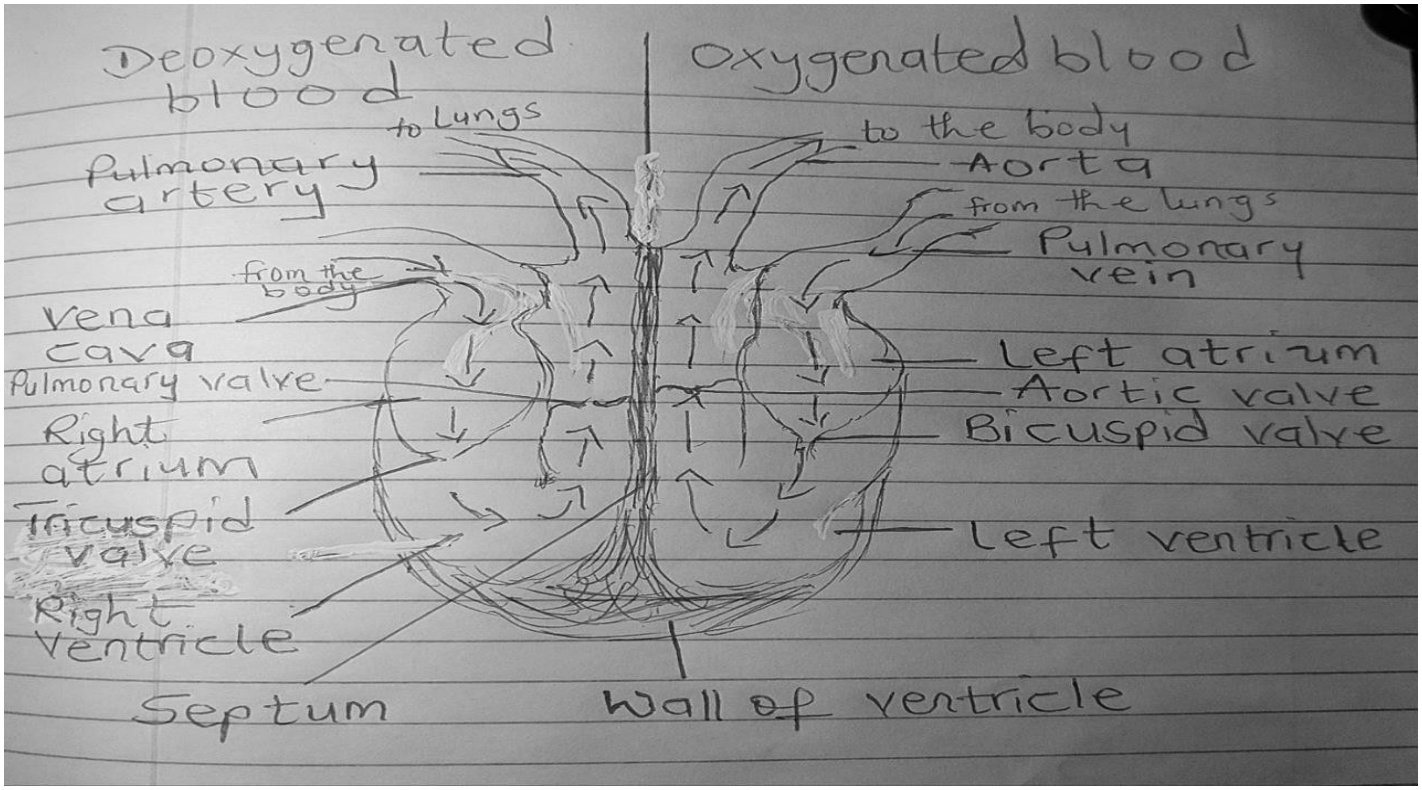
### CIRCULATORY SYSTEM
Every organism must exchange materials with its environment. Exchanges ultimately occur at the cellular level. Vital substances (e.g. Water, oxygen, $CO_2$, nutrients, waste, and hormones) have to move about within the body. In simpler animals, the body is small enough for substances to diffuse from cell to cell. In larger, multicellular organisms, the body is too thick for diffusion to take place. Thus a circulatory system needs to collect various substances and distribute them throughout the body.

Circulatory system is an organ system that is responsible for transporting materials throughout the entire body of an organism. Substances that are transported by the circulatory system includes **nutrients, water and oxygen.** The circulatory system also takes some materials out of the body. This includes **carbon dioxide.** The job of the circulatory system is to allow the transport of materials from one place to another.

### The main components of the circulatory system
- The heart
- Blood vessels
- Blood.

### 1.The heart






The heart is a muscular organ located in the left side of the thoracic cavity.
It consists mainly of cardiac muscle tissue and pumps blood through blood vessels by repeated, rhythmic contractions.

**Human Heart**

The human heart is a vital organ that functions as the central component of the circulatory system.
*It is responsible for pumping oxygenated blood to the body's tissues and organs while simultaneously receiving deoxygenated blood from the body and sending it to the lungs for oxygenation.*
The heart is located in the chest, slightly to the left of the midline, and is protected by the ribcage.

**Four (4) chambers of the heart**

The left side of the heart is responsible for pumping **oxygenated blood to the body**, while the right side of the heart is responsible for pumping **deoxygenated blood to the lungs**.

- The right atrium (upper): This receives oxygen-poor blood from the body and pumps it to the right ventricle.
- The right ventricle (lower): This pumps the oxygen-poor blood to the lungs.
- The left atrium (upper): This receives oxygen-rich blood from the lungs and pumps it to the left ventricle.
- The left ventricle (lower): This pumps the oxygen-rich blood to the body.

**The ventricles have thicker walls compared to the atria.** This is because the ventricles are responsible for pumping blood out of the heart, while the atria receive blood returning to the heart**.** **The ventricles need to generate enough force to push blood throughout the body under high pressure**, so they have thicker muscular walls to support this function. The atria, on the other hand, have thinner walls as they primarily serve as receiving chambers for blood

**Four (4) valves of the heart**

The heart also includes four valves that help regulate the flow of blood.
These valves are

**a**. **The tricuspid valve,** **b. The pulmonary valve,**
**c. The mitral valve,** **d. And the aortic valve.**

**These valves ensure that blood flows in one direction through the heart, allowing for efficient circulation throughout the body.**

**The tricuspid valve** is located between the right atrium and the right ventricle. It prevents the backflow of blood from the right ventricle to the right atrium.

**The pulmonary valve** is located between the right ventricle and the pulmonary artery. It prevents the backflow of blood from the pulmonary artery to the right ventricle.

**The mitral valve, also known as the bicuspid valve**, is located between the left atrium and the left ventricle. It prevents the backflow of blood from the left ventricle to the left atrium.

**The aortic valve** is located between the left ventricle and the aorta. It prevents the backflow of blood from the aorta to the left ventricle.

**The pulmonary vein** carries oxygenated blood from the lungs to the left atrium of the heart. This oxygenated blood is then pumped into the left ventricle and distributed to the rest of the body.

**The pulmonary artery**, on the other hand, carries deoxygenated blood from the right ventricle of the heart to the lungs. In the lungs, the blood picks up oxygen and gets rid of carbon dioxide before returning to the heart.

**The main vein or the vena cava** is not a specific term used to describe a particular blood vessel. However, veins in general are responsible for carrying deoxygenated blood back to the heart. They collect blood from various parts of the body and transport it to the right atrium of the heart.

**The aorta or the main artery** is the largest artery in the body and carries oxygenated blood from the left ventricle of the heart to the rest of the body. It branches out into smaller arteries, which further distribute the oxygenated blood to different organs and tissues.

**So, in summary, the pulmonary vein carries oxygenated blood from the lungs to the heart, the pulmonary artery carries deoxygenated blood from the heart to the lungs, veins collect deoxygenated blood from the body and return it to the heart, and the aorta carries oxygenated blood from the heart to the rest of the body.**

**The septum** separates the left and right sides, preventing the mixing of oxygenated and deoxygenated blood. This ensures that oxygen-rich blood is pumped to the body while deoxygenated blood is sent to the lungs for oxygenation**.**

**Structure of the Heart**

- It is a muscular.
- It has four chambers.
- Chambers on the right side are separated from chambers on the left side by a wall or septum.
- The wall of the lower left side or left ventricle is thicker than the wall of the lower right side or right ventricle.
- Valves are present in the heart.
- Major blood vessels enter or leave the heart.
- The upper chamber is separated from the lower chamber by valves.

**Diseases of the Heart**

- Hypertension or high blood pressure.
- Heart attack
- Cancer of the heart

- Coronary thrombosis
- Hole-in-heart

**NB: The function of the heart is to pump blood.**

**Causes of heart diseases**

- Emotional and psychological stress
- Smoking heavily
- Hereditary
- Overweight or high intake of fats
- Hypertension or high blood pressure or high intake of common salt.
- Excessive alcohol intake or hard drugs.

**Blood pressure** refers to the force exerted by the blood against the walls of the blood vessels (arteries).

It is measured in ***millimeters of mercury (mmhg)*** and is typically expressed as two numbers, such as 120/80 mmhg. The first number, known as systolic pressure, represents the pressure in the arteries when the heart contracts and pumps blood. The second number, known as diastolic pressure, represents the pressure in the arteries when the heart is at rest between beats. Lack of exercise.

**There are two main types of blood pressure**

- High blood pressure (hypertension)
- Low blood pressure (hypotension)

**High blood pressure,** also known as hypertension, is a condition where the force of blood against the walls of the arteries is consistently too high. This can put strain on the heart and blood vessels, increasing the risk of serious health problems such as heart disease, stroke, and kidney disease. It is often referred to as the "silent killer" because it usually has no symptoms, but can cause significant damage if left untreated. Regular blood pressure checks are important to monitor and manage high blood pressure.

**Potential causes of hypertension.**

1. Family history: Having a family history of hypertension can increase your risk.
2. Age: The risk of developing hypertension tends to increase with age.
3. Obesity: Being overweight or obese can put extra strain on the heart and blood vessels.
4. Lack of physical activity: Leading a sedentary lifestyle can contribute to high blood pressure.
5. Unhealthy diet: Consuming too much sodium (salt) and not enough fruits, vegetables, and whole grains can contribute to hypertension.
6. Smoking: Smoking damages blood vessels and can raise blood pressure.
7. Chronic conditions: Certain medical conditions, such as diabetes, kidney disease, and sleep apnea, can increase the risk of hypertension.

**Ways to prevent hypertension:**

1. **Maintain a healthy weight**: being overweight or obese increases the risk of developing hypertension. It is important to maintain a healthy weight through a balanced diet and regular exercise.
2. **Follow a healthy diet:** adopting a diet that is low in sodium, saturated fats, and cholesterol can help prevent hypertension. Include plenty of fruits, vegetables, whole grains, and lean proteins in your diet.
3. **Limit alcohol consumption**: excessive alcohol consumption can raise blood pressure. It is recommended to limit alcohol intake to moderate levels, which is up to one drink per day for women and up to two drinks per day for men.

4. **Reduce sodium intake**: consuming too much sodium can contribute to high blood pressure. Limiting the amount of salt in your diet and avoiding processed foods that are high in sodium can help prevent hypertension
5**. Exercise regularly**: engaging in regular physical activity can help lower blood pressure and maintain overall cardiovascular health. Aim for at least 150 minutes of moderate-intensity aerobic exercise or 75 minutes of vigorous-intensity exercise per week.
6. **Manage stress:** chronic stress can contribute to hypertension. Finding healthy ways to manage stress, such as practicing relaxation techniques, engaging in hobbies, or seeking support from loved ones, can help prevent high blood pressure.
7. **Quit smoking**: smoking damages blood vessels and raises blood pressure. Quitting smoking is essential for preventing hypertension and improving overall health.

**Low blood pressure**, **also known as hypotension**, is a condition where the force of blood against the walls of the arteries is consistently too low. This can result in inadequate blood flow to the organs and tissues of the body. Common symptoms of low blood pressure include dizziness, lightheadedness, fainting, blurred vision, and fatigue. Low blood pressure can be caused by factors such as dehydration, certain medications, heart problems, hormonal imbalances, or underlying health conditions. It is important to consult with a healthcare professional if you are experiencing symptoms of low blood pressure.

**Potential causes of hypotension:**
1. Dehydration: Not having enough fluids in the body can lead to low blood pressure.
2. Medications: Certain medications, such as those used to treat high blood pressure or heart conditions, can cause a drop in blood pressure.
3. Heart problems: Conditions such as heart failure or a weak heart can result in low blood pressure.
4. Endocrine disorders: Disorders such as Addison's disease or low thyroid function can cause hypotension.
5. Nutritional deficiencies: A lack of certain nutrients, such as vitamin B12 or folate, can contribute to low blood pressure.
6. Blood loss: Significant blood loss, whether from an injury or internal bleeding, can lead to hypotension.
7. Infection: Severe infections, such as septicemia, can cause a drop in blood pressure.

**Ways to prevent hypotension:**
1. **Stay hydrated**: Drinking enough water throughout the day can help maintain healthy blood pressure levels. Aim to drink at least 8 glasses of water per day.
2. **Eat small, frequent meals**: Consuming smaller, more frequent meals can help prevent a sudden drop in blood pressure after eating. Include balanced meals that contain a mix of carbohydrates, proteins, and healthy fats.
3. **Avoid standing up too quickly**: When getting up from a sitting or lying position, do so slowly to allow your body to adjust and prevent a sudden drop in blood pressure.
4. **Limit alcohol consumption**: Excessive alcohol consumption can lower blood pressure. It is recommended to limit alcohol intake to moderate levels, which is up to one drink per day for women and up to two drinks per day for men.
5. **Avoid hot environments:** Spending too much time in hot environments, such as saunas or hot tubs, can cause a drop in blood pressure. Be cautious and take breaks to cool down if necessary.
6. **Exercise regularly**: Engaging in regular physical activity can help improve blood circulation and maintain healthy blood pressure levels. Aim for at least 150 minutes of moderate-intensity aerobic exercise or 75 minutes of vigorous-intensity exercise per week.
7**. Talk to your doctor about medications**: If you are taking medications that may lower blood pressure, such as certain antihypertensive drugs or diuretics, discuss with your doctor about potential side effects and how to manage them to prevent hypotension.

## Blood

*Blood is a body fluid that transports oxygen and nutrients to the cells and carries away carbon dioxide and other waste products.* This consists of

- **Blood cells**
- **Plasma**.

## How the blood defends the body against diseases?

- Blood clotting stops pathogens from entering the body.
- The white blood cells attack pathogens. They produce antibodies which destroy antigens.
- The white blood cells produce antitoxins to neutralize toxins and the antibodies give immunity against disease.

## Composition of the human blood

The blood consists of the following;
A. A liquid part called *—plasma"*
*B. Solid part called "blood cells or corpuscles"* (white blood cell, red blood cell, platelets).
C. Dissolved substances (hormones, dissolved food substances, mineral salt, urea, gases).

## 1. Plasma

This is the yellowish watery part of the blood.

**Substances found in blood plasma**

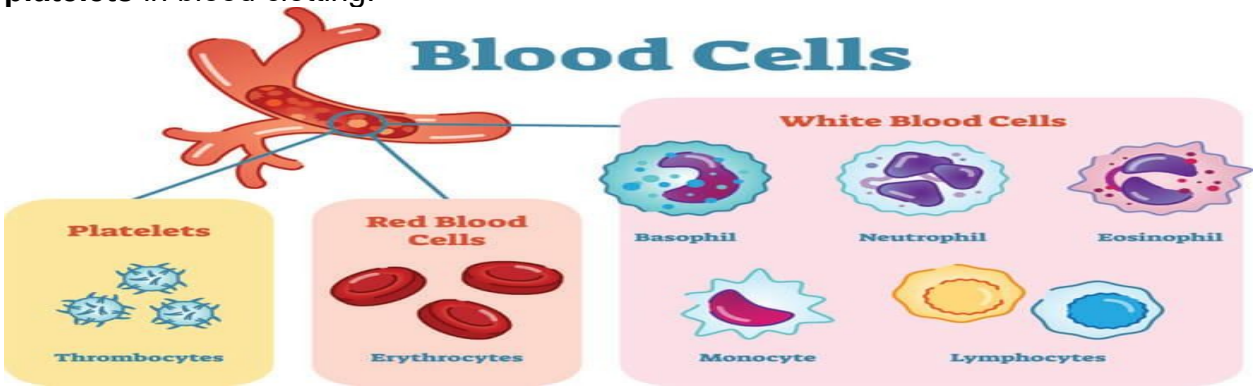
- Water
- Antibodies
- Salt or mineral salts
- Glucose
- Urea or nitrogenous waste
- Amino acids
- Plasma protein or serum albumin
- Mineral ions (e.g. Sodium ion, magnesium ion)
- Vitamins.

## 2. Blood cells

There are three types of blood cells. They are;

- Red blood cells (Erythrocytes)
- White blood cells(Leukocytes)
- Platelets (Thrombocytes)

***NB:*** **Red blood** cells function in oxygen transport, **white blood** cells in immunological defenses, and **platelets** in blood clotting.




**Red blood cells**

**Function:**

- To transport oxygen from the lungs to all part of the body.

- Transport carbon dioxide (small amount

**Features of red blood cell (Erythrocyte)**

- It is biconcave in shape.
- It lacks a nucleus.
- Sausage or disc shape.
- It has haemoglobin at its center or it is red in colour.

**White blood cells**

**Function:**

- Defend the body against microbes or engulfs foreign materials or pathogens.
- Production of antibodies.
- It engulfs or destroy bacteria.

**Location in the human body**

Lymph nodes or bone marrow.

**Functions of white blood cell (Leukocyte)**

- Presence of nucleus
- Irregular or amoeboid in shape
- Presence of intercellular organelle

**Structural differences between red blood cell and white blood cells**

| Red blood cells | White blood cells |
|---|---|
| Biconcave in shape | Irregular or amoeboid in shape |
| Absence of nucleus | Presence of nucleus |
| Small in size | Large in size |
| Absence of intercellular organelle | Presence of intercellular organelle |
| Spongy cytoplasm | Cytoplasm is not spongy. |

**Differences between red blood cell and white blood cells**

| Red blood cells | White blood cells |
|---|---|
| Red in colour or contains haemoglobin | Colourless or straw in colour or no haemoglobin. |
| Have no nucleus | Has nucleus |
| Have a biconcave shape or cannot change shape. | Have nonspecific shape or can change shape. |
| Occur in large number | Less in number |
| Transport oxygen or carbon dioxide | Defend the body |
| Life span is 120 days or long | Life span is shorter |
| Formed in liver and spleen in embryonic stage or formed in marrow after birth. | Formed in bone marrow in both embryonic and adult stages. |

**Platelets**

They are tiny fragment of cells which do not have nucleus. They are produced in the bone marrow. Platelet play a very important role in blood clotting.

**Function:** It aid blood clotting.

**How clotting of blood occurs**

- When blood is exposed to air, prothrombin is converted into thrombin in the presence of calcium ions.
- The thrombin catalyzes the conversion of fibrinogen to fibrin.
- The fibrin forms a meshwork which traps platelets and blood cells to form a clot.

**Importance of blood clotting**

- Blood clot plugs the damaged blood vessels thus initiates its repair.
- It prevents further loss of excessive blood.
- It prevents the entry of pathogens or foreign material into the circulatory system.

**Lymph**

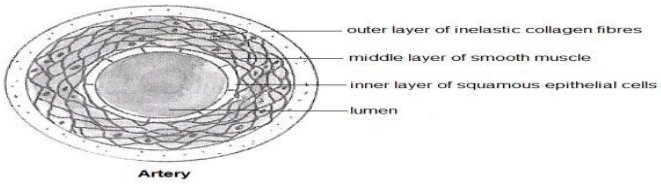
This is the body fluid without red blood cells but with large proteins.
Or it is tissue fluid that flows in the lymph vessels.

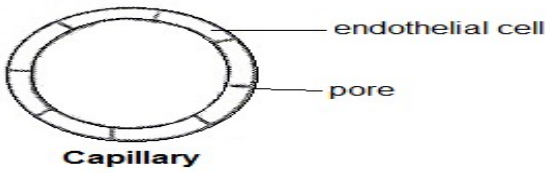
**Functions of lymph**

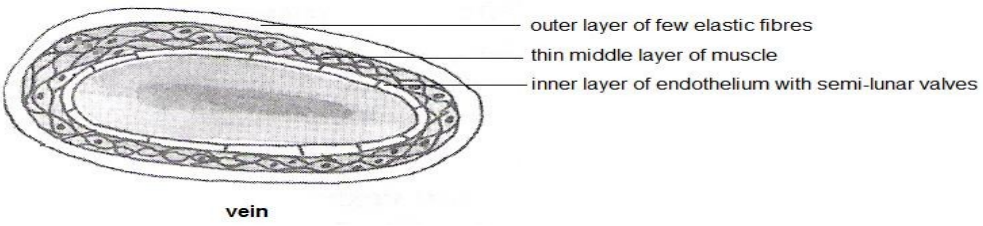
- Medium of exchange of materials or nutrients between the blood and body tissues.
- Carries white blood cells or lymph cells to body tissues (for defense against pathogen invasion).
- Carries digested food materials.
- Takes excess tissue fluids back into the blood.

**3. Blood vessels**

There are essentially three types of blood vessels: arteries, veins and capillaries.
**Arteries:** This take blood away from the heart. Located deep inside the body.
**Veins:** This returns or carry blood towards the heart.
**Capillaries:** This is the exchange of materials between the blood and the tissue or cells




**Adaptation of the artery to its function**

- It has a thick or muscular wall to withstand high pressure.
- The walls are elastic to withstand high pressure.

**Adaptation of the vein to its function**

- **It** has a thin wall to carry blood at low pressure.
- They have valves to prevent back flow of blood.

**Adaptation of the capillaries to its function**

- It is a thin or small in order to penetrate to all parts of the internal organs or tissues.
- They have thin walls for easy diffusion of nutrients, waste products.

**Differences between arteries and veins**

| Arteries | Veins |
|---|---|
| Transport oxygenated blood from the heart to tissues. | Returns blood from the tissues to the heart. |
| Not equipped with valves | Equipped with valves |
| Their walls are thick | Their walls are thin |
| Have elastic walls | Have inelastic walls |

| | |
|---|---|
| They are deeply seated in the body | They are more superficial |
| They carry blood under high pressure | The transport blood under low pressure |
| Have small or narrow lumen | Have a large or wide lumen |

**Functions of hepatic portal vein**

- It carries digested food or glucose from small intestine to the liver.
- It drains blood from the spleen to the liver.

**B9.3.1.1.2 Explain the concept of respiration and show how respiratory system and the circulatory system complement each other.**

**The respiratory system** is the body system that brings air containing oxygen into the body and releases carbon dioxide into the atmosphere. **The job of the respiratory system** is the exchange of gases between the body and the outside air. **Respiration** *is the process by which oxygen is taken into the body to breakdown food substances into smaller form to release energy*.

**Importance of respiration**

- It serves as heat production which enables animals to maintain constant body temperatures.
- Cell division.
- Production of chemical substances in cells.
- Muscle contraction which causes movement in animals.
- Transmission of nerve impulses.
- Breakdown of chemical substances in cells.

**Types of respiration**

1. **Aerobic respiration**

This takes place in the presence of oxygen. There is the production of great amount of energy. The glucose is the substrate or reactant in the chemical process while carbon dioxide and water are produced as by products.

**Products of Aerobic respiration**

- Water, Energy, Carbon dioxide.

**Balanced Equation of Aerobic respiration**

$C_6H_{12}O_6 + 6O_2 \quad 6CO_2 + 6H_2O + Energy$

2. **Anaerobic respiration**

There is no oxygen involved in this type of respiration. Only small amount of energy is produced. In anaerobic respiration, pyruvate produced from glucose in glycolysis is not completely broken down to carbon dioxide and water as in the case of aerobic respiration. This accounts for much less energy produced. In yeast, anaerobic respiration is called alcoholic fermentation. Alcohol (ethanol) and carbon dioxide are produced as by-products with glucose being the substrate.

**Products of Anaerobic respiration**

- Ethanol or alcohol or lactic acid
- Carbon dioxide
- Energy

**Balanced Equation of Anaerobic respiration**

$C_6H_{12}O_6 \quad 2C_2H_5OH + 2CO_2 + Energy$ **Or** $C_6H_{12}O_6 \quad 2CH_3CH_2OH + 2CO_2 + Energy$

**Uses or importance of Fermentation or Anaerobic respiration in industry**

- For the preparation of bread and other foodstuffs.
- Used in the manufacturing of alcoholic beverages.
- Used in the production of antibiotics
- Used in the preservation of foods.

**Differences between Aerobic and Anaerobic respiration**

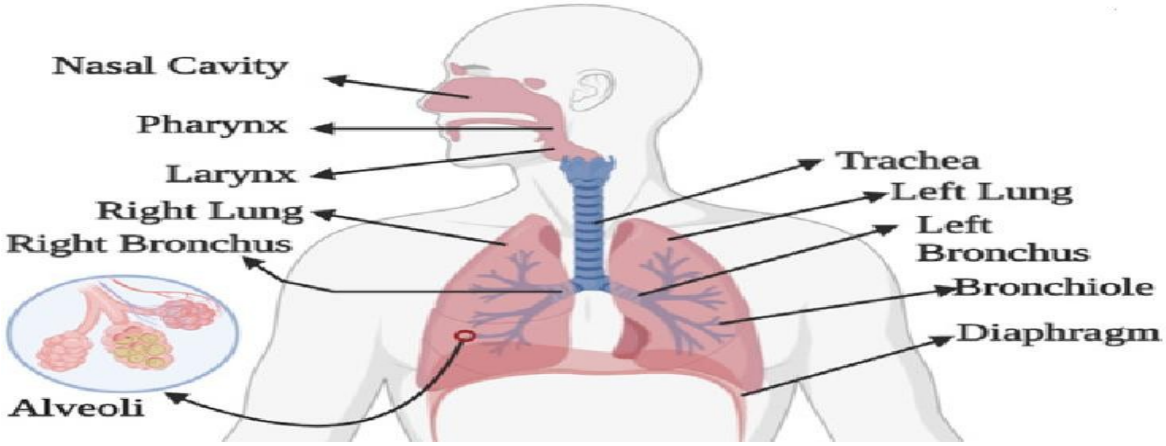
| Aerobic respiration | Anaerobic respiration |
|---|---|
| Oxygen required | No oxygen required |
| A lot of energy produced | Less energy produced |
| Carbon dioxide and water produced as by-products | Alcohol, carbon dioxide or lactic acid produced as by-products. |
| Occurs in mitochondrion | Occurs in cytoplasm |

**Properties common to combustion and respiration**

- Both require oxygen.
- Both give out heat energy.
- They are both chemical change/irreversible
- There is release of energy whenever they occur.

**<u>The path taken by inhaled air beginning from the nostrils to the alveolus OR organs of the human respiratory system.</u>**

**Structure of Human Respiratory System**




| | |
|---|---|
| **Nasal cavity or nostrils** | It has hairs or mucous membrane that removes dust or germs in the inhaled air |
| **Pharynx or glottis (Throat)** | It contains tonsils and adenoids, which are pockets of lymphatic tissue used to trap and filter micro-organisms |
| **Larynx or voice box** | It protects the trachea from foreign object and other particle.<br>It produces sounds and help us to talk. |
| **Trachea or windpipe** | It carries air in and out of the lungs.<br>It protects the respiratory surface from an accumulation of foreign particles. |
| **Bronchi or bronchus** | It represents the airway in the respiratory tract that conducts air into the lungs. |
| **Bronchioles** | It brings air deep into the lung - all parts of the lung. |
| **Alveolus or alveoli** | It is surrounded by a dense networks of blood vessels for gaseous exchange.<br>It has thin walled to facilitate the passage of gases across it.<br>It large surface area to increase the rate of diffusion of gases across it |
| **Diaphragm** | Located at the bottom of the rib cage.<br>Lies between the abdominal cavity and thoracic cavity. |
| **Ribs** | It protects the lungs and also aid in breathing |
| **Lungs** | It is the main organ for gaseous exchange which take place at the alveoli |

## Functions of the mucus lining of the respiratory tract of humans

**Mucus**

*It is a viscous fluid which helps to trap dust particles or microbes that enter the respiratory tract*.

- Mucus contain antibodies that recognize germs which are killed by enzymes in the fluid.
- Mucus traps dust or germ making inhaled air harmless. .

It is muscular in nature which contracts and relaxes to alter the volume of the thoracic cavity.

**Intercostal muscle** The intercostal muscles are a group of muscles located between the ribs in the thoracic (chest) region. These muscles play a crucial role in the mechanics of breathing, specifically in the expansion and contraction of the rib cage during inhalation and exhalation. The intercostal muscles consist of three layers: external intercostals, internal intercostals, and innermost intercostals. Each layer contributes to the intricate process of respiration by aiding in rib movement and lung expansion.

**Function**

- It regulates the variation of the movement of ribs to aid external respiration.
- It involved in inspiration/ expiration/ breathing.

***Explain the concept of respiration and show how respiratory system and the circulatory system complement each other.***

The respiratory system and the circulatory system work together to ensure the efficient exchange of gases in the body. The respiratory system includes organs such as the lungs, trachea, and bronchi, which are responsible for the intake of oxygen and the removal of carbon dioxide.

Once oxygen is inhaled, it enters the bloodstream through tiny blood vessels called capillaries in the lungs. This is where the circulatory system comes into play. The circulatory system, which includes the heart, blood vessels, and blood, transports oxygen-rich blood from the lungs to the rest of the body.

The oxygen-rich blood is pumped by the heart to various organs and tissues, where it releases oxygen and picks up carbon dioxide. The carbon dioxide-rich blood then returns to the heart, which pumps it back to the lungs for exhalation.

***Explain how deoxygenated blood from circulation is oxygenated through inhalation for respiration to take place***

Deoxygenated blood from circulation is oxygenated through inhalation in the respiratory system. When you inhale, you take in air that contains oxygen. This air travels through your nose or mouth, down the trachea, and into the lungs.

Inside the lungs, the inhaled air reaches tiny air sacs called alveoli. The walls of the alveoli are very thin and surrounded by a network of tiny blood vessels called capillaries. These capillaries contain deoxygenated blood from the circulatory system.
As the inhaled air enters the alveoli, oxygen molecules pass through the thin walls of the alveoli and into the surrounding capillaries. At the same time, carbon dioxide, which is a waste product produced by the body's cells, moves from the capillaries into the alveoli.

This exchange of gases between the alveoli and the capillaries is facilitated by diffusion, which is the movement of molecules from an area of high concentration to an area of low concentration. Oxygen moves from the alveoli, where its concentration is higher, into the capillaries, where its concentration is lower. Carbon dioxide moves in the opposite direction, from the capillaries into the alveoli.

Once the deoxygenated blood in the capillaries picks up oxygen from the alveoli, it becomes oxygenated. This oxygenated blood then travels back to the heart through the pulmonary veins and is pumped out to the rest of the body through the systemic circulation.

***In summary, inhalation brings oxygen into the lungs, where it diffuses into the capillaries surrounding the alveoli. This oxygenates the deoxygenated blood from circulation, allowing it to be transported to the body's cells for respiration to take place.***

## *Mechanism of Breathing*

**Breathing** is the process of intake of air or oxygen from the atmosphere into the lungs and the release of air or carbon dioxide from the lungs into the atmosphere.
**Or Breathing** is the exchange of gases between the lungs and the atmosphere.
**Stages of Breathing**

1. **Inhalation (breathing in).** This is process by which mammals or animals take in fresh air from the atmosphere into their lungs.
2. **Exhalation (breathing out).** The process of removing air from the lung.

**Components of inhaled and exhaled air**

| | Inhaled air | Exhaled air |
|---|---|---|
| Carbon dioxide | Less (0.03%) | More (3.5% ) |
| Oxygen | More (21%) | Less (16.9%) |
| Water vapour | Less/ variable | More/ saturated |
| Temperature | Less warm | Warmer |
| Nitrogen | 78% | 78% / remains the same |
| Inert gases | 0.9% | 0.9% / remains the same |

**Differences between inhaled and exhaled air**

| Inhales Air | Exhaled Air |
|---|---|
| Percentage of oxygen is 20% more | Percentage of oxygen is 16% less |
| Percentage of $CO_2$ is 0.03% or low | Percentage of $CO_2$ is 3.5% or high |
| Water vapour content varies | Saturated with water vapour |
| Temperature is the same as that of the atmosphere | Temperature is independent of that of the atmosphere. |

**Differences between Inhalation and Exhalation**

| Inhalation | Exhalation |
|---|---|
| Contraction of external intercostal muscle | Relaxation of external intercostal muscle |
| Ribs and sternum move upwards and outwards | Ribs and sternum move down and inward |
| Diaphragm muscle contracts | Diaphragm muscle relaxes |
| Volume of chest or thoracic cavity increases | Volume of chest or thoracic cavity decreases. |

### Mechanism of Inhalation in humans

- The external intercostal muscles contract and the internal intercostal muscles relax.
- This action causes the ribs and the sternum to move upwards and outwards.
- At the same time, the diaphragm muscles contract, flattening the diaphragm.
- These movements increase the volume of the thoracic or chest cavity.
- The air pressure in the thoracic cavity or lungs falls below the external pressure, and air moves into the lungs.

### Actions which occur during Inhalation in mammals

- Contraction of external intercostal muscles.
- Relaxation of internal intercostal muscles.
- Movement of ribs upwards and outwards.
- Contraction of diaphragm muscle or diaphragm flattens.
- Thorax increases in volume.

- Air pressure in the lungs decreases or volume of lungs increase.
- Air rushes into lungs.

**Ways in which the respiratory system of humans ensures that Inhaled air is purified**

- Hairs at the entrance of nasal cavities or nose first filter the incoming air or trap particles or pathogens.
- Sticky mucus traps bacteria and particles.
- Sensory cells in the nostril ensure sneezing which forcefully ejects foreign particles.
- Cilia or mucus in the trachea or bronchi or bronchioles filter or warm and moisten air before reaching the air sac or traps pathogens.

**Mechanism of Exhalation in humans**

- The muscles of the diaphragm relax causing it to return to its dome-shaped position.
- The intercostal muscles also relax.
- This leads to a reduction in the volume of the thoracic or chest cavity.
- The volume of the lungs reduced as well.
- Pressure in the lungs increases and becomes higher than atmospheric pressure.
- This force air out of the lungs (through the nostrils or the mouth).

**Experiment to show that expired air contains water**

- Expire air is passed unto cobalt chloride paper.
- Cobalt chloride paper turns pink.
- This confirms the presence of water in expired air.

**OR**

- Expire air is passed unto anhydrous $cuso_4$
- Anhydrous $cuso_4$ turns blue.
- This confirm the presence of water in expired air.

**Gaseous exchange in plant during night**

- Oxygen from the atmosphere diffuses through the stomata into the mesophyll layer of the leaf.
- At the same time, carbon dioxide produced in the cells during respiration diffuses out of the cells into the intercellular spaces and passes out through the stomata into the atmosphere.

**Problems and disorders associated with the respiratory system in humans**

- **Lung cancer.** This is uncontrolled and invasive growth of abnormal cells within the lungs.
- **Asthma.** Asthma caused the muscle surrounding the bronchioles to constrict so much that air has difficulty reaching the lungs. Asthma is not contagious and is genetic.
- **Tuberculosis.** Tuberculosis (TB) is an infectious disease that attacks the lungs. TB causes the formation of hard nodules (tubercles) in alveoli.
- **Pneumonia.** Pneumonia is an inflammation of lung tissue, especially in the alveoli, caused by bacteria, viruses, and fungi.
- **Pleurisy**. This is an inflammation of the double membranes surrounding the lungs (pleura).
- **Emphysema** is a respiratory illness caused by swollen lung that leads to shortness breath.
- **Pharyngitis** is an inflammation of the pharynx caused by certain bacterial or viral infection.
- **Tonsillitis** is an inflammation of the tonsils caused bacteria.
- **Bronchitis.** Bronchitis is an inflammation the bronchi caused by a viral infection.
- Whooping Cough
- Hay fever
- Severe Acute Respiratory Syndrome (SARS)

## STRAND 3: SYSTEM
## SUB-STRAND 2: THE SOLAR SYSTEM
### *B9.3.2.1.1 Understand the movement of non-planetary bodies in the solar system.*

**Galaxies** are large groups of stars held together by gravity. The sun and the solar system are a part of a galaxy known as the **Milky Way**. Other galaxies are usually so far away that they look like stars in the night sky. The Andromeda galaxy and the Large Magellanic Cloud are galaxies that can be seen with the naked eye on a clear night.

**A non-planetary body** refers to any object in space that is not classified as a planet. This can include objects such as asteroids, comets, moons, and dwarf planets.

The movement of non-planetary bodies in the solar system, such as asteroids and comets, is influenced by the **gravitational forces exerted by the Sun and other celestial bodies**. These objects typically follow **elliptical or elongated orbits around the Sun.**

**An elliptical orbit** is the movement of one body around another in an oval-shaped path. It can be anywhere from a nearly perfect circle to an elongated oval.

**Here are seven examples of non-planetary bodies:**
1. Moons (e.g., Earth's Moon, Jupiter's moon Europa)
2. Asteroids (e.g., Ceres, Vesta)
3. Comets (e.g., Halley's Comet, Comet Hale-Bopp)
4. Meteoroids (small rocky or metallic objects in space)
5. Dwarf planets (e.g., Pluto, Eris)
6. Kuiper Belt Objects (e.g., Makemake, Haumea)
7. Trans-Neptunian Objects (e.g., Sedna, Orcus)

**An explanation of each of the celestial objects listed above:**
**1. Moons:** Moons are natural satellites that orbit around planets. Examples include Earth's Moon and Jupiter's moon Europa. Moons can vary in size and composition and are often formed from the debris left over after the formation of a planet.

**2. Asteroids:** Asteroids are rocky objects that orbit the Sun. They are smaller than planets and are often found in the asteroid belt, which is located between Mars and Jupiter. Examples of asteroids include Ceres and Vesta.

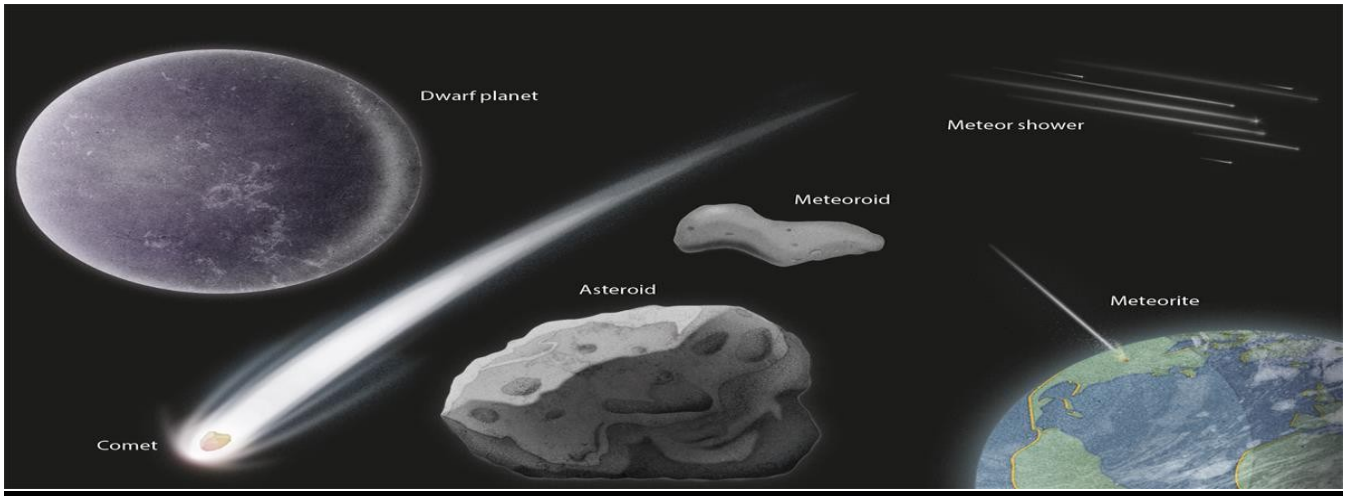
**3. Comets:** Comets are small chunks of ice and rock that come from the outer edge of the solar system. When its orbit brings it closer to the sun, the ice on them vaporizes, creating a beautiful tail behind them. Halley‘s comet is one of the most well-known comets which is visible to the naked eye from the earth every 75-76 years.When a comet's orbit brings it close to the sun, the heat causes the ice to vaporize, creating a glowing coma (a cloud of gas and dust) and sometimes a visible tail that points away from the sun. Comets are often referred to as "dirty snowballs" because of their composition. They are fascinating objects in our solar system and have captivated the interest of astronomers and skywatchers for centuries.

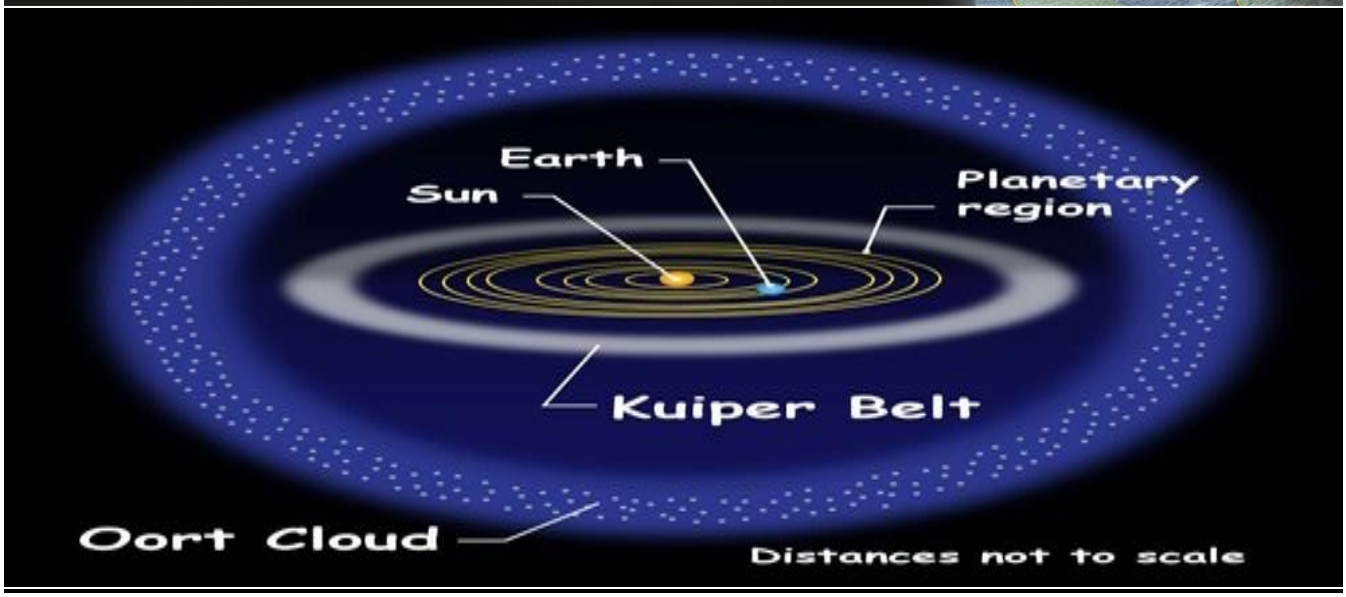
**4. Meteoroids**: Meteoroids are small rocky or metallic objects that are found in space. They are smaller than asteroids and can range in size from a grain of sand to a boulder. When a meteoroid enters Earth's atmosphere and burns up, it is called a meteor. If a meteor survives the journey through the atmosphere and lands on Earth's surface, it is called a meteorite.

**5. Dwarf planets:** Dwarf planets are celestial bodies that orbit the Sun and are similar to planets in terms of their shape and composition. However, they have not cleared their orbits of other debris, which is one of the criteria for being classified as a planet. Examples of dwarf planets include Pluto and Eris.

**6. Kuiper Belt Objects:** Kuiper Belt Objects (kbos) are a group of small icy bodies that orbit the Sun beyond Neptune. They are similar in composition to comets and are believed to be remnants from the early formation of the solar system. Examples of kbos include Makemake and Haumea.

**7. Trans-Neptunian Objects:** Trans-Neptunian Objects (tnos) are a diverse group of objects that orbit the Sun beyond Neptune. They include dwarf planets, kbos, and other small bodies. Examples of tnos include Sedna and Orcus.




**<u>It's important to note that the movement of these non-planetary bodies can be affected by various factors,</u>**

- Such as gravitational interactions with other objects
- Collisions
- The pressure of sunlight.

Scientists study these movements to better understand the dynamics of the solar system and the potential impact of these objects on Earth

**<u>The movement of non-planetary bodies in the solar system, such as asteroids and comets, can be compared and contrasted in several ways</u>**.

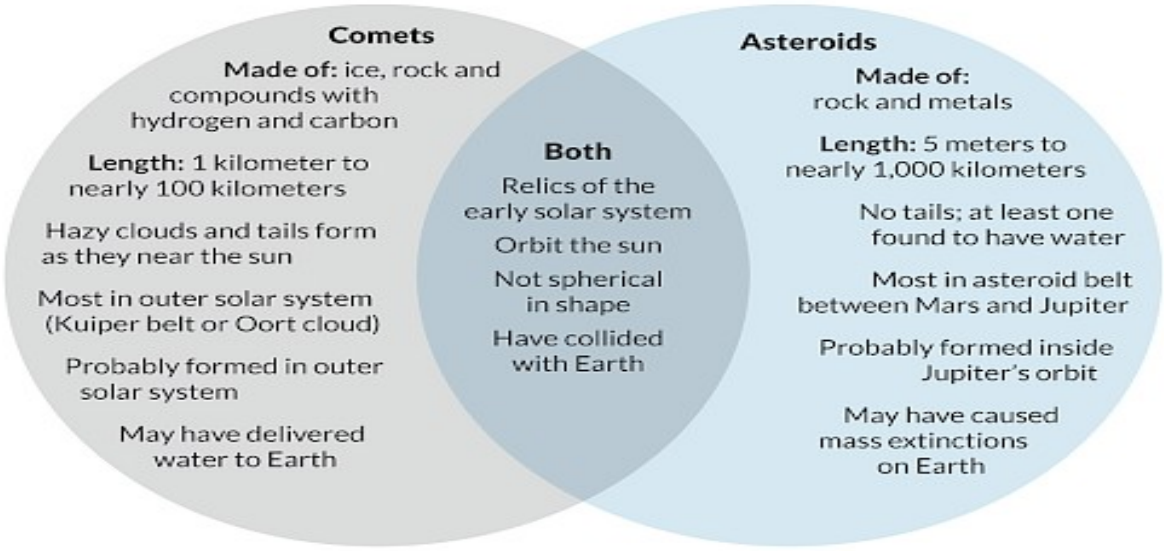
**1. Orbits**: Both asteroids and comets follow elliptical or elongated orbits around the Sun. However, asteroids are primarily found in the asteroid belt between Mars and Jupiter, while comets originate from the outer regions of the solar system.

**2. Composition:** Asteroids are rocky objects, often made up of metals and silicate materials. Comets, on the other hand, are icy bodies composed of water, frozen gases, dust, and rocky particles.

**3. Origins:** Asteroids are remnants from the early formation of the solar system, while comets are believed to originate from the Kuiper Belt and Oort Cloud, which are regions beyond the orbit of Neptune.

**4. Appearance:** When a comet approaches the Sun, the heat causes the icy nucleus to vaporize, creating a glowing coma and often a tail that points away from the Sun due to solar wind. Asteroids, on the other hand, do not typically exhibit a visible coma or tail.

**5. Interactions:** The movement of both asteroids and comets can be influenced by gravitational interactions with other celestial bodies. However, due to their location in the asteroid belt, asteroids are more likely to be influenced by the gravitational pull of nearby planets, causing them to have irregular and intersecting orbits.




## Satellites

**Satellites** are objects that orbit around larger celestial bodies such as planets. In the context of modern technology, satellites refer to human-made objects that are launched into space to orbit the Earth or other celestial bodies for various purposes.

**The two main types of satellites are:**

1. Natural Satellites: These are celestial bodies that orbit a planet, such as the Moon orbiting the Earth.
2. Artificial Satellites: These are human-made objects launched into space to orbit the Earth or other celestial bodies for specific purposes, such as communication, weather monitoring, navigation, and scientific research.

**Uses of satellites include:**

**1. Communication:** Satellite communication enables long-distance transmission of data, television signals, and internet connectivity.
**2. Navigation:** Satellite navigation systems, such as GPS (Global Positioning System), provide accurate location and timing information for various applications, including navigation for vehicles, aircraft, and ships.

**3. Earth Observation**: Satellites are used to monitor and observe the Earth's surface, weather patterns, natural disasters, environmental changes, and agricultural activities.
**4. Scientific Research:** Satellites are utilized for scientific research in fields such as astronomy, space exploration, and the study of the Earth's atmosphere and climate.
**5. Military and Defense:** Satellites play a crucial role in military and defense operations, including reconnaissance, surveillance, intelligence gathering, and communication.

## TEST YOUR MIND

**1) How many planets are there in the Solar System?**
**(**a) 9 (b) 8 (c) 7 (d) 10
Answer: (b) 8
Explanation**:** There are eight planets in the Solar System. The eight planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.
**2) Which planet is the closest to the Sun?**
Mercury is the closest planet to the Sun. At an average distance of just 57.9 million km, Mercury orbits closer to the Sun than any other planet.
**4) Solar System is located in _____ galaxy.**
Answer: Milkyway
Explanation: Solar system is located in the Milkyway galaxy.
**5) Why is it called the Solar System?**
The planetary system is named the —solar system‖ because the Sun is named Sol, after the Latin word for Sun, —Solis,‖ and anything related to the Sun is known as —solar.‖ Our planetary system is located in an outer spiral arm of the Milky Way galaxy.
**Q6) Where do most comets arrive from?**
Comets are believed to have two sources. Short-period comets originate from the Kuiper Belt, and Long-period comets originate from the Oort Cloud.
**7) How did the Solar system originate?**
The Solar System originated 4.6 billion years ago from the gravitational collapse of a giant interstellar molecular cloud.
**8) What is a solar system made of?**
The solar system consists of the Sun—an average star in the Milky Way Galaxy—and those bodies orbiting around it:

- Eight planets with approximately 170 known planetary satellites
- Numerous asteroids, some with their satellites
- Comets and other icy bodies
- Expansive reaches of highly tenuous gas and dust known as the interplanetary medium

**9) Is solar system expanding?**
Solar systems do not expand despite existing in an expanding universe because of the binding force of gravity.
**Q10) Is Sun the hottest in the Solar System?**
The hottest place in the Solar System is the Sun. The temperature of the Sun‘s surface is a mere 5,800 Kelvin, while the centre of the Sun is around 15 million Kelvin.

**Explain the following.**

**1. What do we mean by celestial bodies?**
Celestial bodies or heavenly bodies refer to the planets, stars, moons and all the other natural objects present in space.
Q2**How many types of celestial bodies are present?**
Celestial bodies or heavenly bodies include:
1) Planets 2) Stars 3) Satellites
4) Comets 5) Asteroids
6) Meteors and Meteorites 7) Galaxies
Q3**Where are most of the asteroids found?**
Most of the asteroids are found in the asteroid belt which is a region between Mars and Jupiter.
Q4**What are comets?**
Comets are small chunks of ice and rock that come from the outer edge of the solar system. When its orbit brings it closer to the sun, the ice on them vaporizes, creating a beautiful tail behind them.
Halley‘s comet is one of the most well-known comets which is visible to the naked eye from the earth every 75-76 years.
Q5**Which galaxy are we a part of?**
The sun and our solar system are a part of the Milkyway galaxy.
Q6**What is the one major difference between planets and stars?**
Unlike planets, stars produce their own source of light. Planets just reflect the light coming from another star like the sun.

## STRAND 3: SYSTEMS
## SUB-STRAND 3: ECOSYSTEM
### B9.3.3.1.1 Conduct research into the composition of an ecosystem and discuss how the components depend on each other for survival

**A food chain** is a linear sequence of organisms, where each organism is a source of food for the next organism in the chain. It represents the flow of energy and nutrients from one organism to another in a specific ecosystem. A food chain typically starts with a producer, such as a plant, which is then consumed by a primary consumer, which is then consumed by a secondary consumer, and so on. It helps us understand the transfer of energy and the relationships between different organisms in a simplified manner.

**Consumers** are organisms that obtain their energy by consuming other organisms. They are also known as heterotrophs, as they *cannot produce their own food through photosynthesis like producers (such as plants) can.* Consumers can be classified into different categories based on their feeding habits. For example, herbivores are consumers that eat only plants, carnivores are consumers that eat other animals, and omnivores are consumers that eat both plants and animals. Decomposers, such as bacteria and fungi, are also considered consumers as they obtain energy by breaking down dead organic matter. These different types of consumers play important roles in maintaining the balance of energy and nutrients within an ecosystem.

**Primary consumers** are organisms that directly consume producers, such as plants or algae. They are also known as herbivores. Examples of primary consumers include rabbits, deer, and cows. They primarily feed on plants and are herbivores.

**Secondary consumers** are organisms that feed on primary consumers. They are also known as carnivores or omnivores. Examples of secondary consumers include wolves, lions, and bears. They feed on primary consumers, such as rabbits or deer, and are carnivores or omnivores.

**Tertiary consumers** are organisms that feed on secondary consumers. They are usually apex predators and are at the top of the food chain. Tertiary consumers are often apex predators, such as sharks, eagles, or tigers. They feed on secondary consumers and are at the top of the food chain.

**1. Herbivores:** These are consumers that eat only plants. They obtain their energy by consuming leaves, stems, fruits, or other parts of plants. Examples include cows, rabbits, and deer.

**2. Carnivores:** These are consumers that eat other animals. They obtain their energy by consuming the flesh of other animals. Examples include lions, wolves, and snakes.

**3. Omnivores:** These are consumers that eat both plants and animals. They obtain their energy by consuming a combination of plant and animal matter. Examples include humans, bears, and raccoons.

**4. Scavengers:** These are consumers that feed on dead animals or decaying organic matter. They obtain their energy by consuming the remains of other organisms. Examples include vultures, hyenas, and some species of beetles.

**5. Decomposers:** These are consumers that obtain their energy by breaking down dead organic matter. They play a crucial role in recycling nutrients back into the ecosystem. Examples include bacteria and fungi.

**There are a few rules to keep in mind when constructing a food chain:**

1. The food chain always starts with a producer, which is usually a plant or algae that can produce its own food through photosynthesis.
2. The primary consumers, which are herbivores, feed on the producers.
3. The secondary consumers, which are carnivores or omnivores, feed on the primary consumers.
4. Tertiary consumers, which are often apex predators, feed on the secondary consumers.
5. Decomposers, such as bacteria and fungi, break down dead organisms and organic matter, returning nutrients to the soil or water and completing the food chain.

**Here are four different examples of food chains:**

**1. Grass → grasshopper → frog → snake → hawk**

In this food chain, grass is the producer, grasshopper is the primary consumer, frog is the secondary consumer, snake is the tertiary consumer, and hawk is the apex predator.

**2. Algae → zooplankton → small fish → large fish → shark**

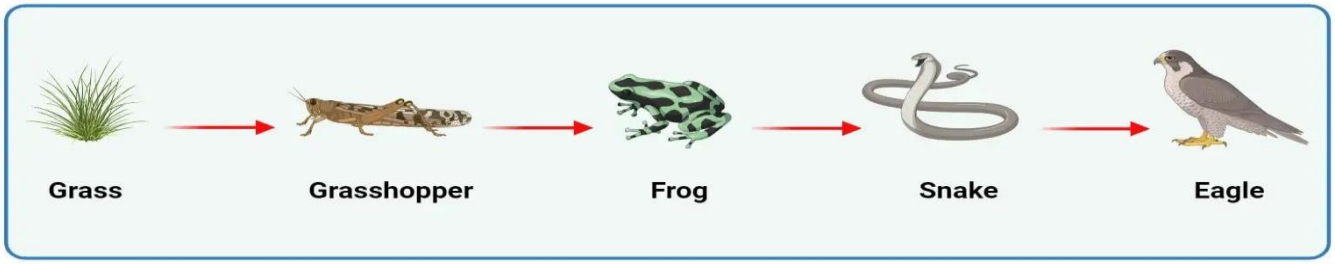
In this marine food chain, algae is the producer, zooplankton is the primary consumer, small fish is the secondary consumer, large fish is the tertiary consumer, and shark is the apex predator.

**3. Acacia tree → giraffe → lion**

In this African savanna food chain, the acacia tree is the producer, giraffe is the primary consumer, and lion is the secondary consumer.

**4. Sunflower → bee → bird → fox**

In this food chain, sunflower is the producer, bee is the primary consumer, bird is the secondary consumer, and fox is the tertiary consumer.

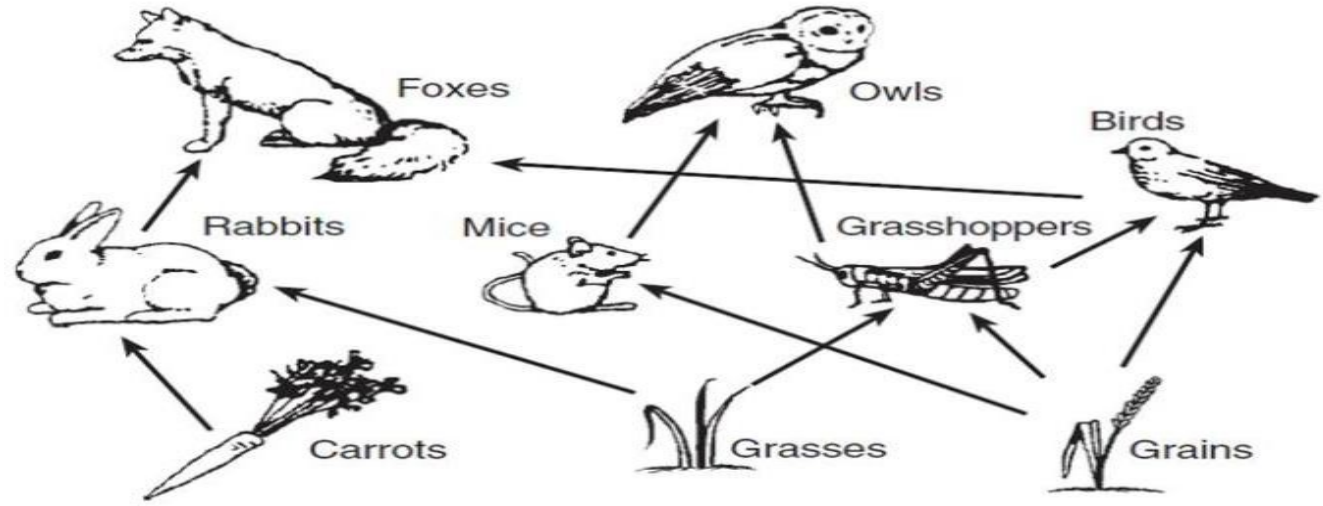



**A food web** is a complex feeding relationships between different organisms in an ecosystem. It shows how energy and nutrients flow through the ecosystem, with arrows indicating the direction of energy transfer from one organism to another. It includes producers, consumers, and decomposers, and helps us understand the complex interactions and dependencies between different species in an ecosystem.

**The rules for constructing a food web include the following:**

1. Identify Organisms: Start by identifying the various organisms within the ecosystem, including producers (plants), primary consumers (herbivores), secondary consumers (carnivores or omnivores), and decomposers.
2. Feeding Relationships: Determine the feeding relationships between the organisms. For example, which organisms are eaten by others and which organisms consume them.
3. Arrows: Use arrows to represent the flow of energy and nutrients between different organisms. Arrows should point from the organism being consumed to the consumer.
4. Multiple Connections: Recognize that many organisms have multiple connections within the food web, as they may be eaten by different predators or may consume multiple types of food.
5. Complexity: Reflect the complexity of the ecosystem by including as many different species and feeding relationships as possible. This can help depict the intricate interdependencies within the ecosystem.

6. Balance: Strive to maintain a balanced representation of the different trophic levels within the ecosystem, from producers to top consumers, to accurately depict energy flow and nutrient cycling.




**Importance of food web and food chain**

1. Shows how plants and animals are connected
2. Helps maintain balance in ecosystems
3. Ensures all living things have enough to eat
4. Demonstrates the interdependence of different species

| Difference Between Food Chain And Food Web | |
|---|---|
| **Food Chain** | **Food Web** |
| A linear pathway showing the flow of energy | A multitude of networks showing the flow of energy |
| An organism of higher level trophic feeds on a specific organism of lower trophic level | An organism of a higher trophic level has access to more members of a lower trophic level. |
| Does not affect the adaptability and competitiveness of organisms. | It has a role in improving the adaptability and competitiveness of an organism. |

**Habitat.** This is a particular place within the environment where organism lives.
There are two types of habitat. These are

- Aquatic habitat (these are organisms that lives on water. E.g. Fish, sea weeds, sharks etc.)
- Terrestrial habitat (these are organisms that lives on land.)
- Arboreal ecosystems are habitats for organisms that live in trees, providing them with food, shelter, and other conditions to thrive.

**An ecosystem** is a community of living organisms (plants, animals, and microorganisms) in conjunction with the nonliving components of their environment (air, water, and mineral soil), interacting as a system.

| **Ecosystem** | **Habitat** |
|---|---|
| Larger | Smaller |
| Larger number of species | Smaller number of species |
| Involves different species | Involves a specific species |

**Balance in an ecosystem** refers to the state of equilibrium or stability within the interactions and relationships among organisms and their environment. It means that the populations of different species are in a harmonious state, with no one species dominating or being overly scarce.
In a balanced ecosystem, the populations of organisms are able to maintain a sustainable level, ensuring that resources such as food, water, and shelter are available for all species. This balance is important because it allows for the efficient cycling of nutrients, energy flow, and the overall functioning of the ecosystem.

When an ecosystem is out of balance, it can lead to negative consequences. For example, if a predator population becomes too dominant, it can cause a decline in prey species, disrupting the food chain and potentially leading to the collapse of the ecosystem. Similarly, if a certain species becomes too scarce or extinct, it can have cascading effects on other species and disrupt the overall balance.

**Activities that promote balance in an ecosystem include:**
1. Conservation and protection of natural habitats
2. Sustainable resource management
3. Restoration of degraded ecosystems
4. Promotion of biodiversity
5. Reduction of pollution and waste
6. Responsible fishing and hunting practices
7. Control of invasive species
8. Education and awareness about the importance of ecosystem balance.

**Activities that can destroy balance in an ecosystem**:
1. Deforestation
2. Pollution
3. Overfishing
4. Introduction of invasive species
5. Habitat destruction

**Imbalance in an ecosystem** refers to a situation where there is a disruption or disturbance in the natural balance of the ecosystem. This can occur when there is an overabundance or scarcity of certain species, or when there are changes in environmental factors such as temperature, water availability, or nutrient levels. Imbalances can have negative impacts on the overall health and functioning of the ecosystem.

**Activities that can lead to imbalance in an ecosystem include:**
1. Deforestation
2. Pollution
3. Overfishing
4. Introduction of invasive species
5. Habitat destruction
6. Overuse of natural resources
7. Climate change
8. Land degradation
9. Fragmentation of habitats
10. Disruption of natural processes.

**Activities that can help prevent imbalance in an ecosystem include:**
1. Conservation and protection of natural habitats
2. Sustainable resource management
3. Restoration of degraded ecosystems
4. Promotion of biodiversity
5. Reduction of pollution and waste
6. Responsible fishing and hunting practices

7. Control of invasive species
8. Education and awareness about the importance of ecosystem balance
9. Implementation of environmental regulations and policies
10. Collaboration and cooperation among different stakeholders to ensure sustainable practices.

**Negative effects of imbalance in the ecosystem on organisms include:**
1. Loss of biodiversity
2. Disruption of food chains
3. Decline in population sizes
4. Habitat destruction
5. Increased vulnerability to diseases and parasites

**Endangered species** are species of plants or animals that are at risk of becoming extinct. They have a very small population size and are facing threats such as habitat loss, pollution, climate change, and illegal hunting or poaching.

**Activities that can lead to endangerment of species include:**
1. Habitat destruction and fragmentation
2. Pollution and contamination of ecosystems
3. Climate change and global warming
4. Overexploitation through hunting, fishing, or poaching
5. Introduction of invasive species
6. Deforestation and land conversion
7. Illegal wildlife trade
8. Loss of genetic diversity through inbreeding or hybridization
9. Changes in natural fire regimes
10. Disease outbreaks or epidemics.

**Interference such as earthquakes, volcanic eruptions, hunting, farming, mining, pollution, pesticides, and bush burning can have various effects on the balance in an ecosystem.**
Here are some predictions and justifications for how these interferences can impact the ecosystem:
**1. Earthquakes:** Earthquakes can cause significant disturbances in an ecosystem. They can lead to habitat destruction, changes in land topography, and even alter water bodies. This can disrupt the natural balance of the ecosystem by displacing or killing organisms, affecting their food sources, and changing the availability of resources.
**2. Volcanic eruptions:** Volcanic eruptions release ash, gases, and lava, which can have both immediate and long-term effects on ecosystems. The ash can smother plants and animals, while the gases can lead to air pollution. The lava can destroy habitats and alter the landscape. These disruptions can impact the balance by reducing biodiversity, changing nutrient availability, and affecting the overall functioning of the ecosystem.
**3. Hunting:** Overhunting can lead to the decline or extinction of certain species. When a predator is removed from an ecosystem, it can cause an imbalance in the population dynamics of other species. For example, if a predator is overhunted, its prey population may increase rapidly, leading to overgrazing or overconsumption of resources, which can have cascading effects on other organisms in the ecosystem.
**4. Farming:** Intensive farming practices can have negative impacts on ecosystems. The use of chemical fertilizers and pesticides can contaminate soil and water, affecting the health of plants, animals, and microorganisms. Additionally, the conversion of natural habitats into agricultural land can lead to habitat loss and fragmentation, reducing biodiversity and disrupting ecological interactions.
**5. Mining:** Mining activities can cause habitat destruction, soil erosion, and water pollution. The extraction of minerals can disrupt ecosystems by removing vegetation, altering waterways, and

releasing toxic substances into the environment. These disturbances can affect the balance by reducing habitat availability, contaminating food sources, and harming the health of organisms.
**6. Pollution:** Pollution, whether it's air, water, or soil pollution, can have detrimental effects on ecosystems. It can lead to the death of plants and animals, reduce biodiversity, and disrupt ecological processes. For example, water pollution can harm aquatic organisms and disrupt the balance of aquatic ecosystems, while air pollution can affect the health and survival of both plants and animals.

## Test your mind

**2.** Which is the best example of predation in an ecosystem?
A. Bee and flower **b. Fox and rabbit**
C. Flea and rat d. Mosquito and human
**2.** Which represents a positive consequence of competition within an ecosystem?
A. Decreased rate of reproduction
**B. Elimination of inferior organisms**
C. Increased need for natural resources
D. Elimination of entire species of organisms
**3.** Which of these is an abiotic element of a desert ecosystem?
**A. Sand** b. Cactus c. Lizard d. Scorpion
**4.** If krill (small shrimp-like marine fish) is a primary food source for a local population of whales, which will most likely happen to the whales if the krill population suddenly doubles?
A. The whales will have to compete more with each other for available food.
B. The whales will have to find another food source or risk starvation.
C. The whales will migrate to another area.
**D. The whales will increase in number.**
**5**. Which human action would most likely increase the population of cave-nesting animals in an ecosystem?
A. Cutting nesting trees
B. Tracking nesting foxes
**C. Adding nesting boxes**
**6**. Which best describes the effect of human society on a freshwater ecosystem?
A. Movement of minerals and stones due to flowing water in a stream results in a constantly changing water bed.
B. Erosion caused by running water breaking down the river bank changes the geography of the river bed over time.
**C. The discharge of hot water into a freshwater ecosystem results in decreased levels of oxygen available to organisms.**
**7.** A woodland area where deer live is partially cleared to build homes for people. Which best describes how the deer population will change as a result of clearing the land to build homes?
A. The deer population will increase.
**B. The deer population will decrease**.
C. The deer population will remain the same.
**8.** Which is an example of parasitism?
A. Cat and mouse b. Tadpole and frog
**C. Human and tapeworm**
9. The following is a food chain observed in a large wilderness park.
Vegetation → Deer → Cougar
A swarm of insects consumes 70% of the vegetation in the park. As a result, which of the following willmost likely occur?
**A. The prey will decrease in numbers.**
B. The predator will increase in numbers.
C. The prey will be unaffected.
D. The predator will be unaffected.
**10.** Mice, rabbits, bobcats, and squirrels all live in a brush ecosystem. Which animal would have the MOST difficult time surviving if the population of the other three animals continued to decrease?
A. Mouse b. Squirrel **c. Bobcat** d. Rabbit

## STRAND 3: SYSTEMS
## SUB-STRAND 4: FARMING SYSTEMS
### *B9.3.4.1.1 List and explain the different plant and animal waste used in preparing different types of manure*

**Manure** is organic materials used as fertilizer to provide nutrient for plants. It is made up of animal waste, such as dung and urine, as well as plant material. Manure is rich in nutrients that can help improve soil fertility and promote plant growth

**Factors that affect the choice of manure**
- The types of crops to be grown
- The physical or chemical properties of the soil
- Availability of the manure
- The prevailing climate and weather conditions.

**Types of manure**

**1. Green manure:** This is the formed from leguminous crops or other fresh plants which are ploughed into the soil while they are still growing.

**3. Farmyard manure:** This is a combination of animal wastes or animal beddings.

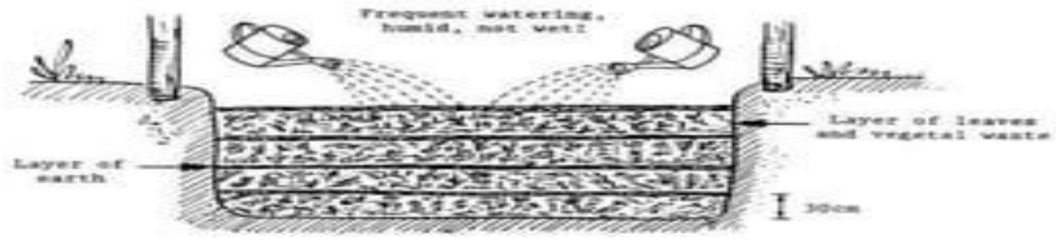
**3. Compost** is a type of organic matter that is created through the decomposition of various organic materials, such as food scraps, yard waste, and other biodegradable materials. It is a natural process where microorganisms break down the organic matter, resulting in a nutrient-rich soil amendment. Compost is commonly used in gardening and agriculture to improve soil quality, retain moisture, and provide essential nutrients for plants. It is an environmentally friendly way to recycle organic waste and reduce the need for chemical fertilizers.

**Starters.** Are materials that help kickstart the decomposition process in a compost pile. *They provide the necessary nutrients and microorganisms that break down organic matter into nutrient-rich compost.* Some common starters include fruit and vegetable scraps, coffee grounds, tea bags, and crushed eggshells.

**Methods of composting**

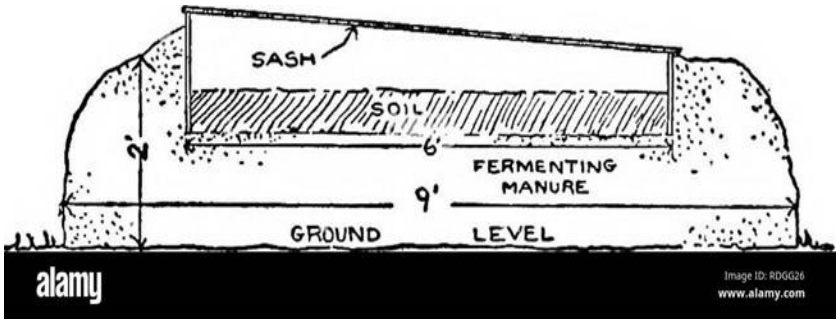
I. **Pit method**

Pit composting is a method of composting where organic materials are placed in a pit or hole in the ground. This method involves digging a pit or trench, usually about 1-2 feet deep, and filling it with a mixture of organic waste, such as food scraps, yard waste, and other biodegradable materials. The pit is then covered with soil or a layer of straw to help retain moisture and promote decomposition




**Ii. Stack or Heap methods**

The heap method of composting involves creating a large pile or heap of compost materials. This method requires less maintenance and turning compared to the stack method. It is commonly used for smaller-scale composting or home composting.




**Organic materials that can be added to the compost**

1. Cut grass
2. Leaves
3. Maize stover
4. Lawn chippings
5. Animal manure

**Principles involved in composting**

1. Site selection
2. Gathering of compost materials
3. Waste management
4. Aeration the compost
5. Monitoring the compost
6. Include starters

**Importance of composting**

1. Reduces waste
2. Decreases greenhouse gas emissions
3. Improves soil fertility
4. Retains moisture in the soil
5. Suppresses pests and weeds

**B9.3.4.1.3 Engage in the preparation of different types of manure**

**Some general steps in preparing manure:**

1. Collect the manure: Start by collecting animal waste, such as cow, horse, or chicken manure. Make sure to gather it from a reliable source.
2. Composting: Composting is an important step in preparing manure. Create a compost pile or bin and add the manure to it. You can also mix it with other organic materials like straw, leaves, or kitchen scraps to enhance the composting process.
3. Turn the pile: Regularly turn the compost pile to ensure proper aeration and decomposition. This helps speed up the breakdown of organic matter and prevents the formation of odors.
4. Monitor moisture levels: It's important to maintain the right moisture levels in the compost pile. The ideal moisture content is around 50-60%. If the pile becomes too dry, add water; if it becomes too wet, add dry materials like straw or leaves.
5. Allow time for decomposition: Depending on the type of manure and the composting conditions, it may take several weeks to several months for the manure to fully decompose. During this time, monitor the temperature and moisture levels regularly.
6. Curing: Once the manure has decomposed, it's important to let it cure or age for a few months. This allows any remaining pathogens to die off and ensures a safe and nutrient-rich end product.
7. Storage and use: After curing, the manure is ready to be stored or used as a fertilizer. Store it in a dry, covered area to prevent nutrient loss. When using it as a fertilizer, apply it to your garden or plants according to the recommended application rates.

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 1: ENERGY
### *B9.4.1.1 .1 List the ways such as ironing in bulk, using energy efficient appliances and switching off appliances when not in use to conserve energy.*

**Energy conservation** refers to the practice of reducing energy consumption or using energy more efficiently in order to minimize waste and preserve natural resources. It involves making conscious choices and taking actions to reduce energy usage in various aspects of our daily lives, such as in our homes, transportation, and industries. The goal of energy conservation is to reduce our overall energy demand and lessen the negative environmental impacts associated with energy production and consumption.

**Law of conservation of energy**

**The law of conservation of energy** states that energy cannot be created nor destroy, but it can be converted or transform or transfer from one form to another.

**Ways of conserving energy or how energy is conserved**

- Putting out fire lamps when not in use.
- Switching off electric appliances when not in use.
- Closing all windows and doors when using an air conditioner.
- Not leaving fridges and deep freezers open for a long time.
- Not putting hot food in fridges and deep freezers.
- Use energy saving lamps.
- Ironing clothes in bulk.

**Efficiency of energy conservation**

**Efficiency of energy** is the practice of using less energy to perform the same task

**Ways Of Conserving Energy**.

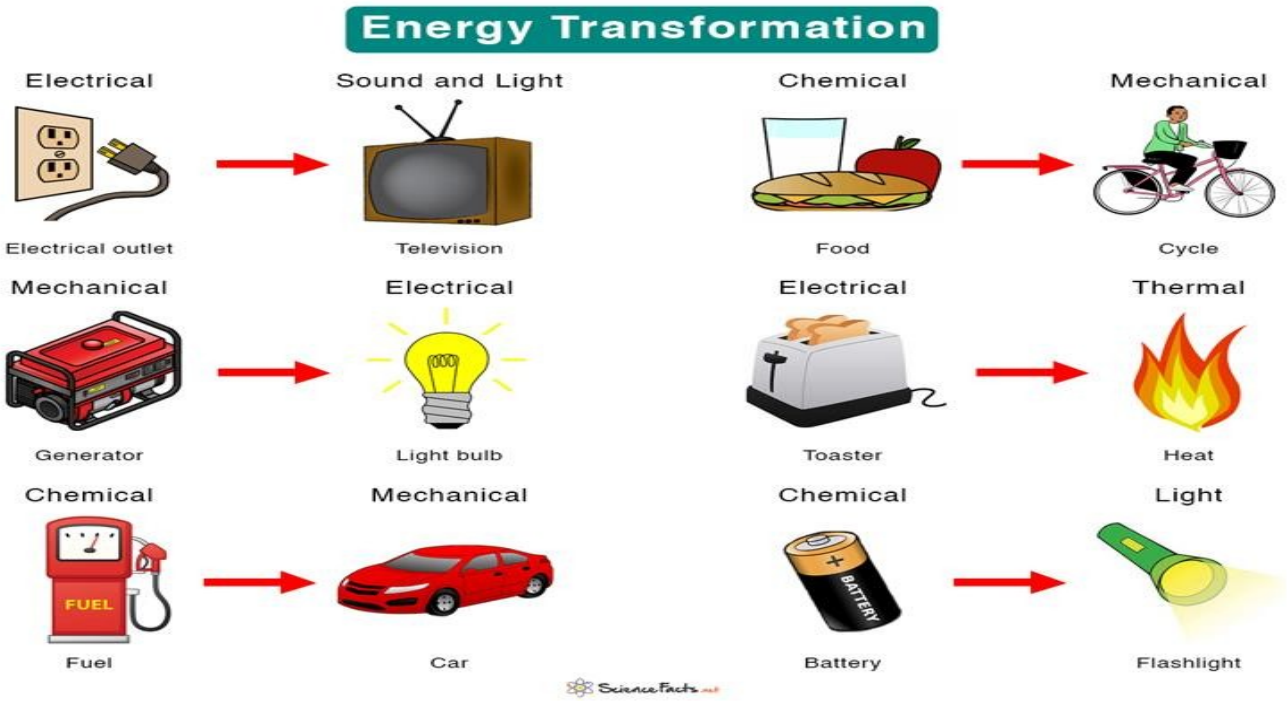
1.Use energy efficient light bulbs
2. Iron all dresses in bulk but not in bit.
3. Do not put your television in the standby mode.
4. Turn off your electrical gadgets when they are not in use.
5.Close all doors and windows when using an air conditioner.

**Energy should be conserved for several reasons**.

Here are a few:

1. Environmental Impact: Conserving energy helps reduce the demand for fossil fuels, which are major contributors to air pollution and climate change. By using energy more efficiently, we can reduce greenhouse gas emissions and protect the environment.
2. Resource Preservation: Many sources of energy, such as coal, oil, and natural gas, are finite resources. Conserving energy helps ensure that these resources last longer and can be used by future generations.
3. Cost Savings: Energy conservation can lead to significant cost savings for individuals, businesses, and governments. By using energy more efficiently, we can reduce our energy bills and allocate those savings to other important areas.
4. Energy Security: Conserving energy reduces our dependence on imported energy sources. By relying more on renewable energy and using energy efficiently, we can enhance our energy security and reduce vulnerability to supply disruptions.

**Examples of energy transformation**




**14. Electric bell**

Electrical energy Magnetic energy Kinetic energy Sound energy

**15. Television set is switched on**

Light energy sound energy heat energy

**16. Hydroelectric dam**

Potential energy Kinetic energy Electromagnetic energy Electrical energy.

**17. Torchlight is switched**

Chemical energy electrical energy heat energy light energy

**18. Ceiling fan**

Electrical energy Mechanical energy

**19. Respiration**

Chemical energy heat energy

**20. Photosynthesis**

Light energy chemical energy

## *B9.4.1.2.1 Demonstrate that light changes path when it travels from one medium to a different medium*

**Refraction of light**

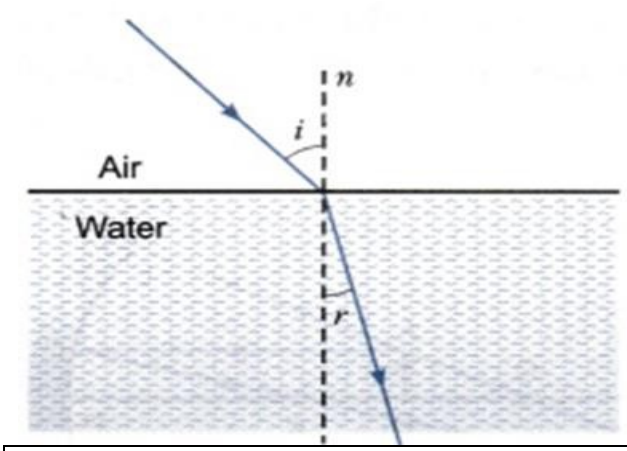
**Refraction of light** is the change in the direction of light when it travels (at an angle) from one medium to another of different density.

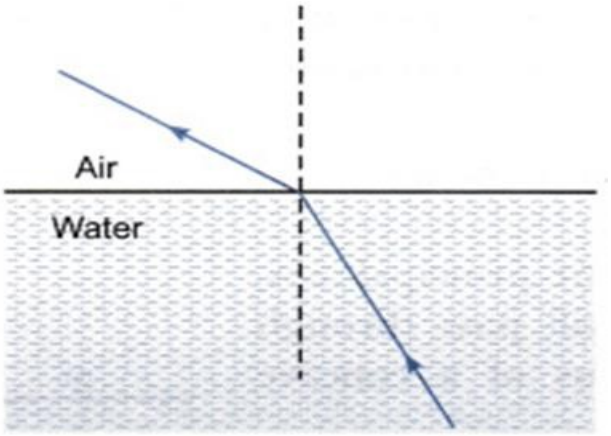
**Laws of refraction**

1. The incident and the refracted rays (are on opposite sides of the normal) at the point of incidence all three lies in the same plane.
2. The ratio of the sine of the angle of incidence to the sine of the angle of refraction is constant for any two-given media. **(This is also known as Snell's law)**

If light enters any substance with a **higher refractive index (such as from air into glass) it slows down**. **The ray bends towards the normal**. Also If light enters into a substance with a **lower refractive index** (such as from glass or water into air) it speeds up. **The light bends away from the normal line**.

## The path of a ray of light as it passes from air to water




| | |
|---|---|
| Light enters any substance with a **higher refractive index (such as from air into glass or water) it slows down**. **The ray bends towards the normal** | Light enters into a substance with a **lower refractive index** (such as from glass or water into air) it speeds up. **The light bends away from the normal line**. |

**Why light bends when it moves from air into water**

- ✓ Air is less dense than water
- ✓ The velocity of light in air is greater than the velocity of light in water.
- ✓ Thus, any ray passing from air into water will bend towards the normal in water.
- ✓ Thus, the ray bends away from its original path.

### *B9.4.1.2.2 Describe how images are formed in cameras*

**Image** This is formed when two or more rays meets or appear to meet.

**Types of image**

**1. Real image.** This is formed by **actual intersection** of two or more rays from an object. This can be obtained on screen. It is always inverted. Example is image produced in a camera.

**2. Virtual image.** This is formed by the **apparent intersection** of two or more rays from an object. It cannot be formed on screen. It is always erect. Example is the image formed in the plane mirror. It is represented by dotted rays or lines.

**A pinhole camera**

A pinhole camera is a simple camera that uses a small hole or aperture to capture images. It doesn't have a lens like traditional cameras, but instead, it relies on the principle of light passing through a small opening and projecting an inverted image onto the film or sensor inside the camera. The pinhole camera is known for its simplicity and can be made using everyday materials

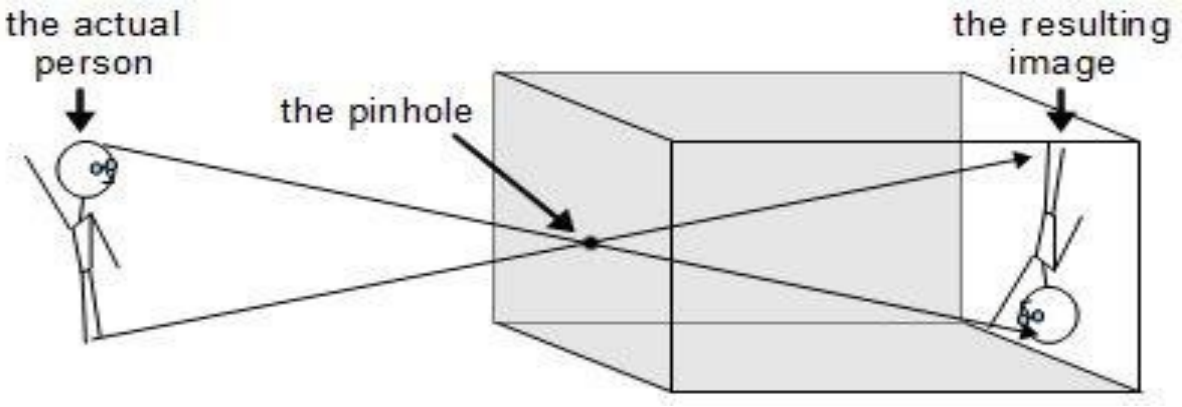
**Formation of images in the Pin – Hole Camera**

Light rays from various parts of the object placed in front of the pin-hole camera travels in a straight line through the hole and hit the screen forming tiny patches of image.

The image becomes inverted because light rays from the top of the object hit the screen near the top. The image formed is also real because it is formed by actual intersection of light rays and it can be formed on a screen.

The image is also diminished. If the hole is made smaller, the image becomes very sharp. But if the hole is made bigger the image becomes blurred and brighter.

This is because bigger holes act as multiples of holes allowing light from many parts of the object to produce overlapping images forming a blurred image.




**The characteristics of image form on a pinhole camera**

The image is

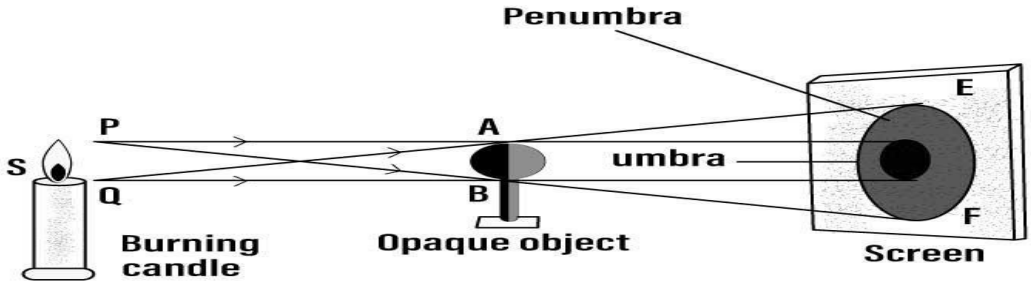
A. Diminished b. Real c. Inverted

## *B9.4.1.2.3 Describe the formation of shadows*

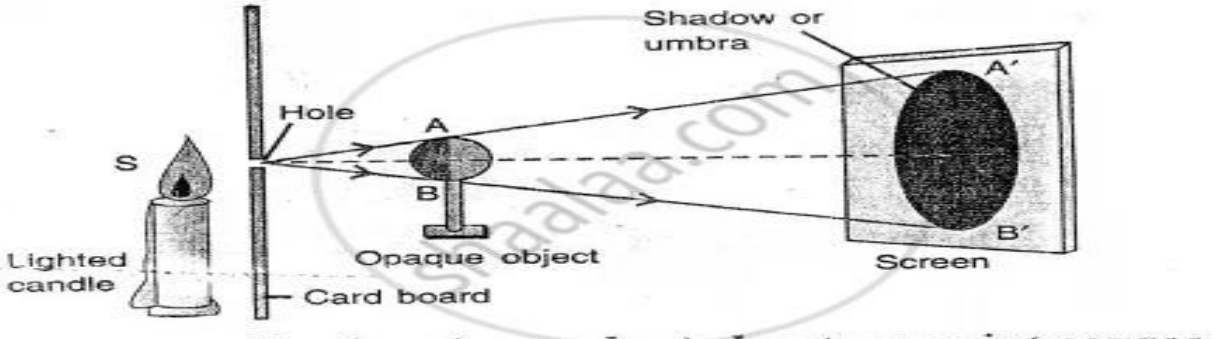
**Shadows** a shadow is a dark area or shape that is formed when an opaque object blocks the path of light. When light from a source, such as the sun or a lamp, is obstructed by an opaque object, it creates an area behind the object where light cannot reach. This absence of light creates a shadow. Shadows are typically seen as darker areas compared to the surrounding environment because they receive less or no direct light. The size and shape of a shadow depend on the position and size of the object blocking the light source.

**Types of shadows**

- **Umbra**. This is the area of total darkness. It is normally formed from a point source of light.
- **Penumbra.** This is the area of partial darkness. It is normally formed from an external source of light. It is formed around an umbra.




**Shadow (umbra and penumbra both) due to an extended source of light**




*Shadow (or umbra) due to a point source*

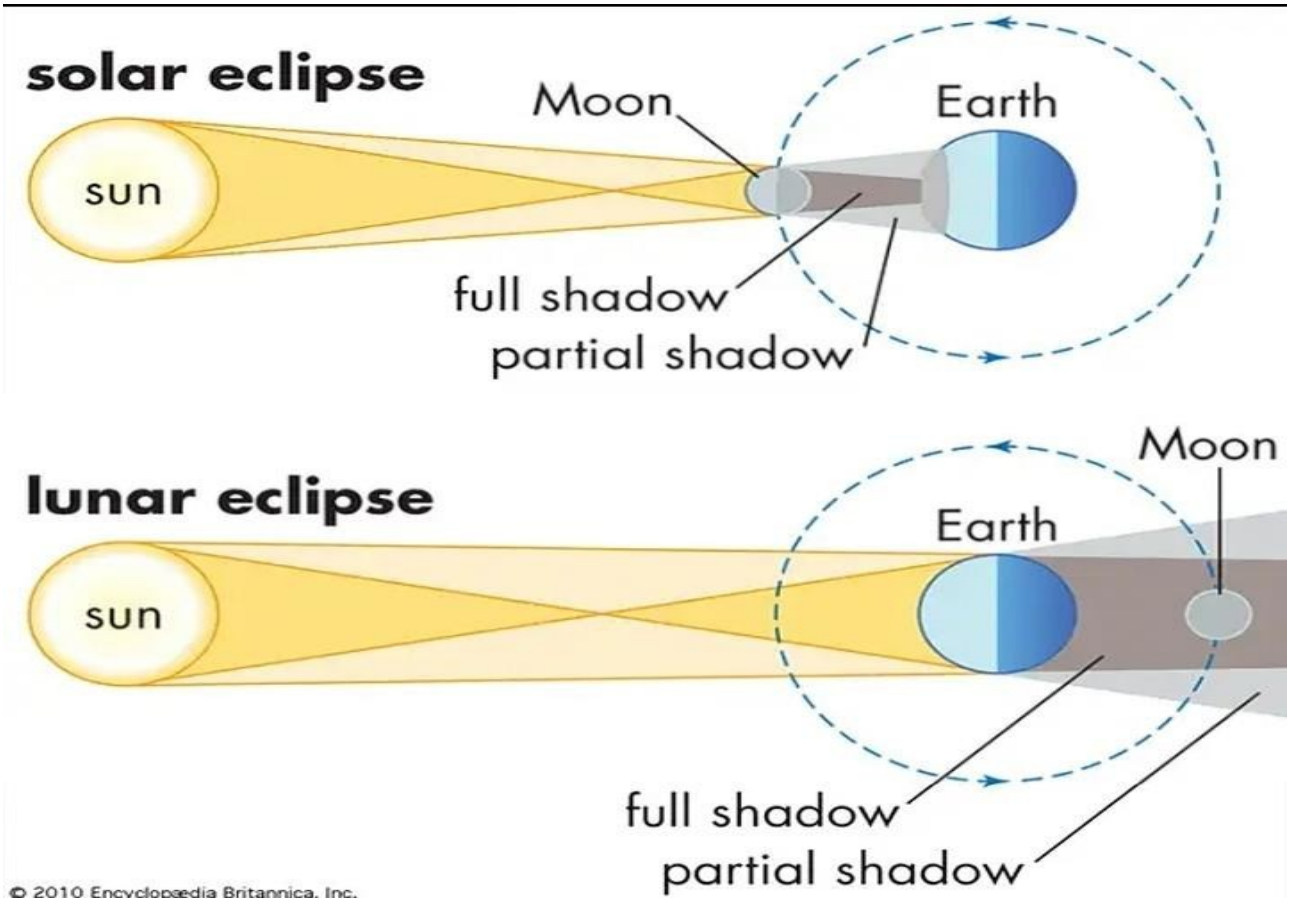
## *B9.4.1.2.4 Demonstrate the formation of an eclipse*

**Eclipse**
This is the total or partial disappearance of the sun or moon as seen from the earth.

**Types of Eclipse**

1. **Solar eclipse (Eclipse of the sun).** This occurs when the moon comes between the sun and the earth and the moon cast its shadow on the surface of the earth.

2. **Lunar eclipse (eclipse of the moon).** This occurs when the earth comes between the sun and the moon and the earth cast its shadow on the moon. It occurs a full moon day. We can observe up to three lunar eclipse per year.




**Differences between solar eclipse and lunar eclipse.**

| Solar Eclipse | Lunar Eclipse |
|---|---|
| Occurs when the Moon passes between the Earth and the Sun, blocking the Sun's light. | Occurs when the Earth passes between the Sun and the Moon, casting its shadow on the Moon. |
| Moon obstructs sunlight, causing a temporary darkening of a portion of the Earth's surface. | Earth's shadow falls on the Moon, causing it to darken or turn reddish in a total or partial eclipse. |
| Only visible within a narrow path on the Earth's surface where the Moon's shadow falls (totality). | Visible from any location on the nighttime side of the Earth where the Moon is above the horizon. |

| | |
|---|---|
| Can be total, partial, or annular depending on the alignment and distance between the Earth, Moon, and Sun. | Can be total, partial, or penumbral, depending on the extent of the Earth's shadow covering the Moon. |
| Occurs during the New Moon phase. | Occurs during the Full Moon phase. |
| Requires eye protection to view safely due to the Sun's intense brightness. | Safe to view with the naked eye; no eye protection needed to observe the eclipsed Moon. |

**Effects of an eclipse:**

1. Darkening of the Sky: During a solar eclipse, the sky darkens as the Moon passes between the Earth and the Sun, blocking the sunlight.

2. Temperature Drop: The temperature can drop during a solar eclipse due to the reduction in sunlight and the blocking of solar radiation.

3. Animal Behavior: Some animals may exhibit changes in behavior during an eclipse, such as birds returning to their nests or nocturnal animals becoming active.

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 2: ELECTRICITY AND ELECTRONICS

**B9.4.2.1.1 Demonstrate transformation of electrical energy to other forms of energy in both series and parallel circuits and perform simple calculations involving flow of current in circuits**

**Electricity** is the flow of electrical charges from one point to another through a conductor

**A circuit** is a closed loop or pathway through which electric current can flow.
It consists of various components, such as *wires, resistors, capacitors, and switches, connected together to form a complete path for the flow of electricity.* Circuits can be found in many electronic devices and systems, and they are essential for the functioning of electrical and electronic devices.

**Types of current**

• **Direct current (D.C):** An electric current which flows in only one direction or an electric current where electrons flow in the same direction all the time.

• **Alternating current (A.C):** An electric current which continuously changes its direction of flow by moving forwards and backwards.

**Differences between D.C and A.C**

| D.C | A.C |
|---|---|
| 1. Voltage is constant | Voltage varies. |
| **2.** Direction of current is constant. | Direction of current changes. |
| **3.** Does not induce current in another coil. | Induces current in another coil. |

**Note: A rectifier is a device that converts A.C to D.C.**

**Sources of current electricity**

- Cells (dry/wet cells) D.C – converts chemical energy to electrical energy.
- Generators (A.C) – mechanical energy to electrical energy.
- Solar cells (D.C) – turn solar energy into electricity.

**Electrical components**

**1. Resistors:** Resistors limit the flow of electrical current in a circuit, control voltage levels, and protect components from excessive current.

**2. Cell:** A cell is a single unit that converts chemical energy into electrical energy, providing power to electronic devices.

**3. Battery:** A battery is a collection of cells connected together to store and provide electrical energy for electronic devices.

**4. Connecting wires**: Connecting wires establish physical connections between electronic components, allowing the flow of electrical current and signals within a circuit.

**5. Capacitors:** Capacitors store and release electrical energy, filter out noise or unwanted signals, and stabilize voltage levels in electronic circuits.

**6. Transistors:** Transistors amplify or switch electronic signals, serving as fundamental building blocks in electronic circuits for tasks such as amplification, switching, and signal processing.

**7. Bulb:** A bulb (incandescent or LED) converts electrical energy into light energy when current passes through it.

**8. P-N junction diode :** A P-N junction is the interface between a semiconductor's P-type material (with an excess of positive charge carriers) and N-type material (with an excess of negative charge carriers), forming the basis of diodes and transistors. It allows current flow in one direction.

**9. LED (Light-Emitting Diode):** An LED is a semiconductor light source that emits light when an electric current passes through it, commonly used in indicators, displays, and lighting applications.

**10. Key (Switch):** A key or switch controls the flow of current in a circuit by opening or closing the circuit path.

**11. Ammeter**: An ammeter measures the electric current flowing through a circuit in amperes (amps).

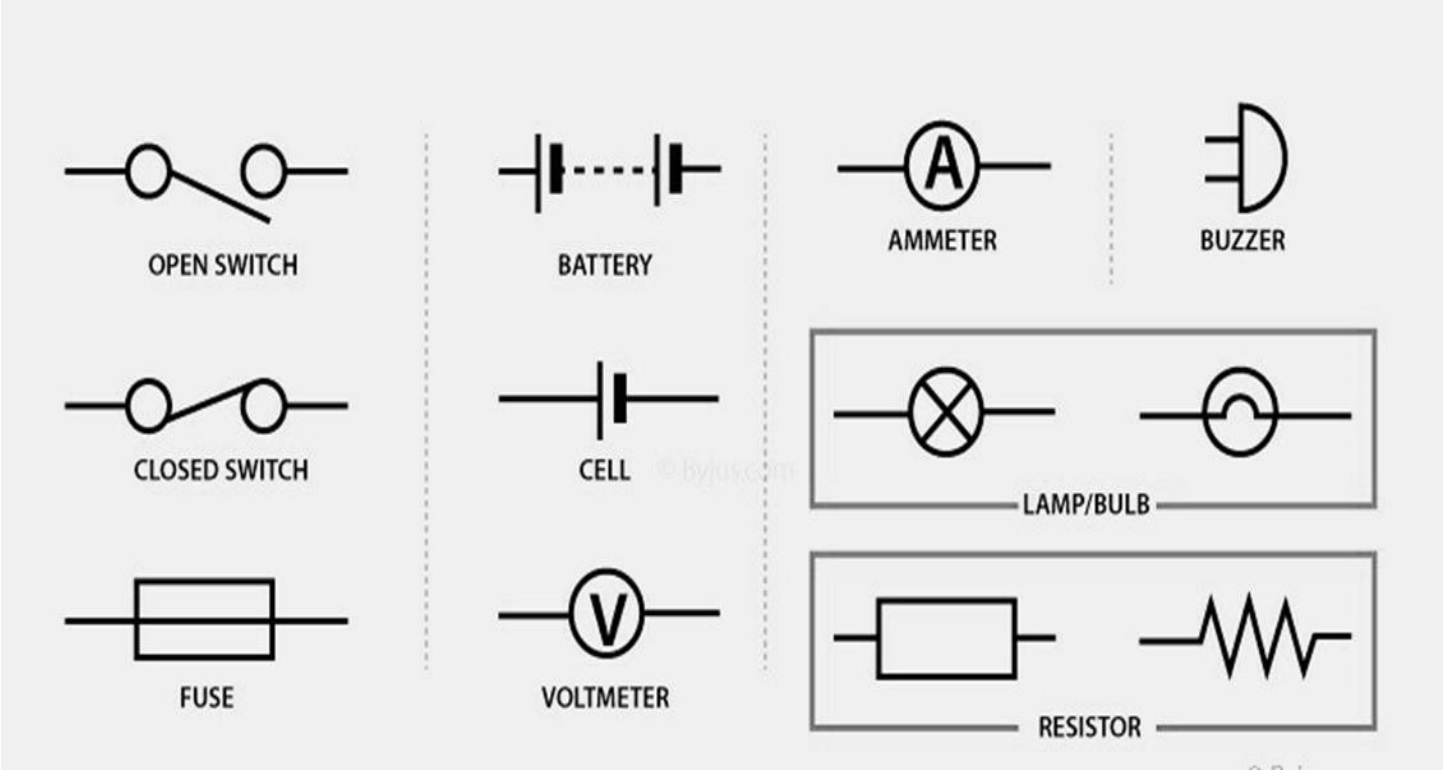
**12. Voltmeter:** A voltmeter measures the voltage difference between two points in a circuit in volts.

**13. Ohmmeter:** An ohmmeter measures the electrical resistance of a component or circuit in ohms.

**14. Inductors:** Inductors store energy in a magnetic field when current flows through them and are used in filters, oscillators, and power supply circuits.

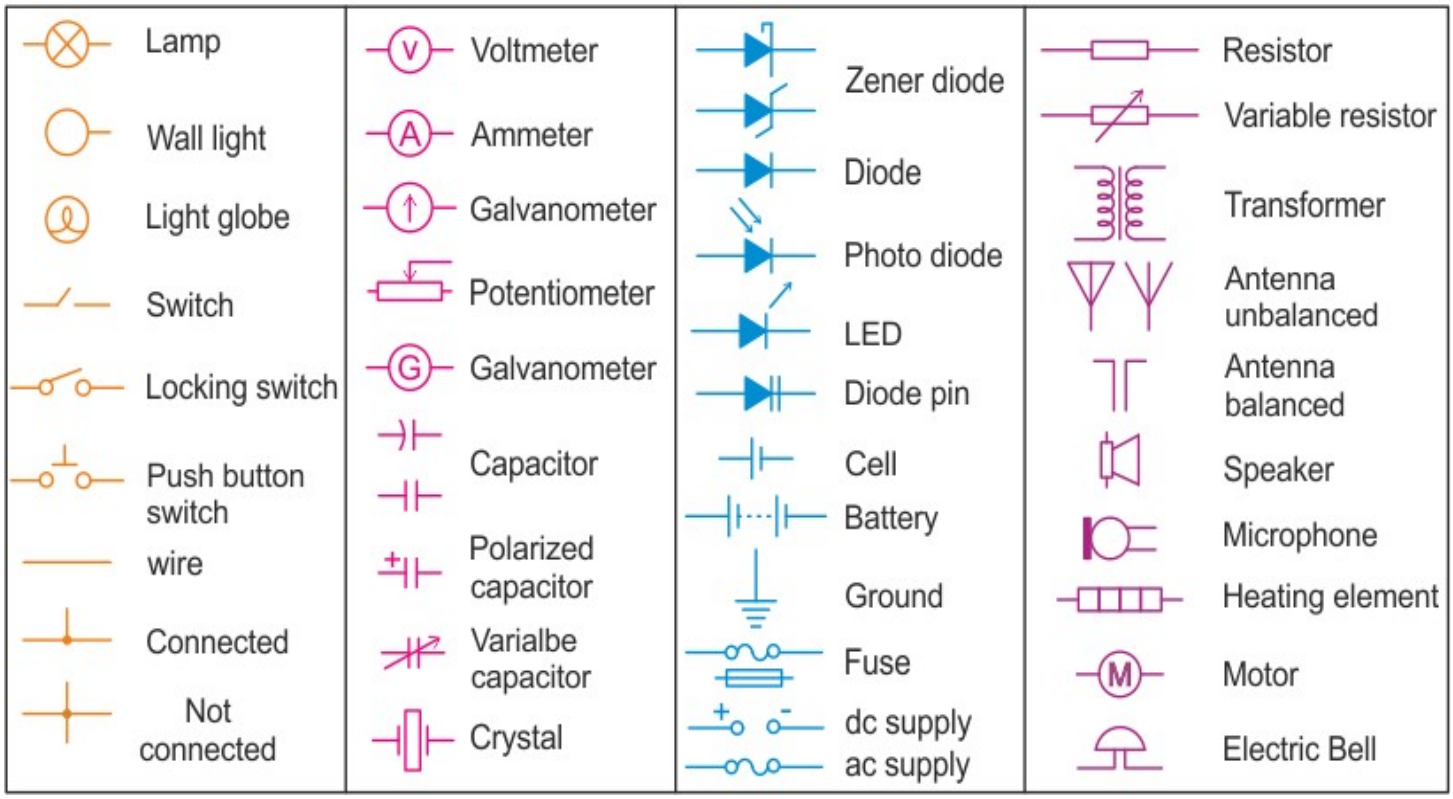
**15. Variable resistors (rheostat):** Variable resistors allow for adjustable resistance in a circuit, useful for controlling voltage levels or adjusting device setting

**16. A resistor color code** is a system of colored bands used to indicate the resistance value, tolerance, and sometimes the temperature coefficient of a resistor. By interpreting the colors of these bands, one can determine the resistance value of the resistor.



testbook

## Electronic Circuit Symbols

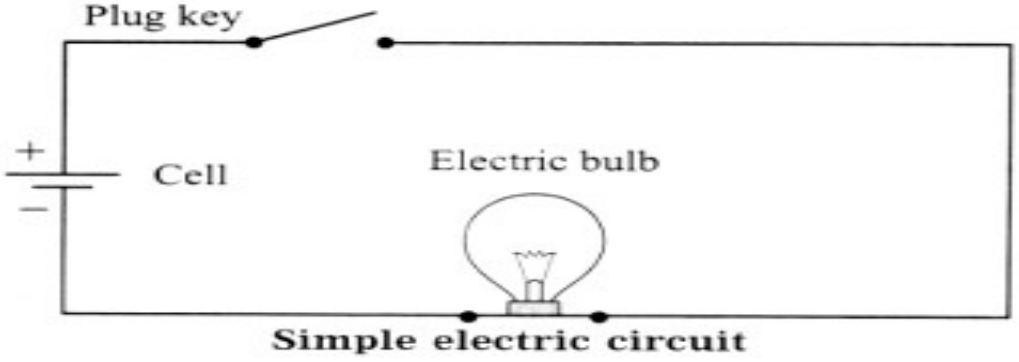



**<u>The impact of changes in electrical circuits can have different effects on the output of bulbs</u>**.
Here are a few scenarios:
1. Increasing the voltage: If the voltage supplied to the bulb increases, the bulb will likely produce more light and appear brighter. However, if the voltage exceeds the bulb's rated voltage, it may cause the bulb to burn out or fail.

2. Decreasing the voltage: If the voltage supplied to the bulb decreases, the bulb may produce less light and appear dimmer. If the voltage drops too low, the bulb may not light up at all.

3. Changing the resistance: The resistance in a circuit affects the amount of current flowing through it. If the resistance increases, the current flowing through the bulb may decrease, resulting in a dimmer light output. Conversely, if the resistance decreases, the current may increase, causing the bulb to appear brighter.

4. Adding or removing bulbs in a series circuit: In a series circuit, adding more bulbs will increase the total resistance, which can result in a decrease in the brightness of each bulb. Removing bulbs will decrease the total resistance, potentially causing the remaining bulbs to appear brighter.



Simple electric circuit

## OHM'S LAW

**Ohm's law** *states that the current flowing through a metallic conductor is proportional to the potential difference between the end of the conductor , provided that the temperature of the conductor remain constant.*

In mathematical terms, **Ohm's law is expressed as I = V/R,**

Where I is the current flowing through the conductor in amperes (A),
V is the voltage across the conductor in volts (V),
And R is the resistance of the conductor in ohms (Ω).

**1. Resistance (R):** . **Resistance** is therefore the opposition to the flow of electrical current through a circuit. The unit of resistance is the **ohm (** and is represented by the symbol "R". **Note:** *Smaller resistors have high resistance while bigger resistors have low resistance.*

**2. Voltage (V):** Voltage, also known as electric potential difference, is the force that pushes electric charges through a circuit. It is measured in volts (V) and is represented by the symbol "V".

**3. Current (I):** Current is the flow of electric charge in a circuit. It is measured in amperes (A) and is represented by the symbol "I" The electrons always flow from a negative point to a positive (or less negative) point, because electrons have a negative charge

**Electrical voltage** is often compared to pressure in a water system. The two ideas are not exactly the same. But they are enough alike to make the comparison useful. You may find electricity easier to understand at first if you think of voltage as a sort of "electrical pressure" that pushes electric current through a wire or through a piece of equipment.
Another common name for voltage is electromotive force, abbreviated emf. This term is used by many people, but it is misleading. Electromotive force is not the same as the force of gravity or the force that a tool exerts on a workpiece. It refers to the same "electrical pressure" as voltage, and it is measured in volts.

### Examples of Calculations Involving V = IR

1. If a circuit has a resistance of 10 ohms and a current of 2 amperes flowing through it, what is the voltage across the circuit? Solution:
Using Ohm's law, we can calculate V = IR = 2 A×10 Ω = 20 V.

2. A light bulb has a resistance of 50 ohms and is connected to a 120-volt power source. What is the current flowing through the bulb? Solution:
Using Ohm's law, we can calculate I = V/R = 120 V / 50 Ω = 2.4 A.

3. A resistor is connected in series to a 9-volt battery, and the current flowing through the circuit is 0.5 amperes. What is the resistance of the resistor? Solution:
Using Ohm's law, we can calculate R = V/I = 9 V / 0.5 A = 18 Ω.

4. An electric motor is rated at 24 volts and has a resistance of 3 ohms. What current will the motor draw when it is connected to a 24-volt power source? Ans: 8 A.

### Arrangement of Resistors, cells in a circuit..

1. Series arrangement/connection.
2. Parallel arrangement/connection.

### Series connection

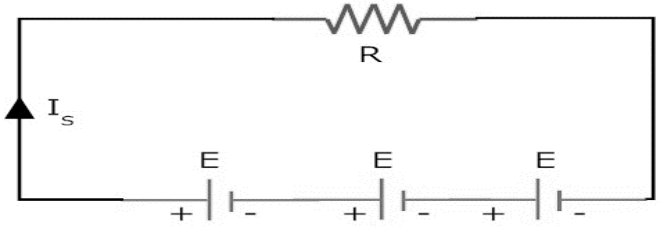
The definition of a series circuit is a circuit where the components are connected end-to-end in a line. In a series circuit, electrical energy flows through each component one after the other, like a line of people holding hands. This means that the current is the same in all parts of the circuit

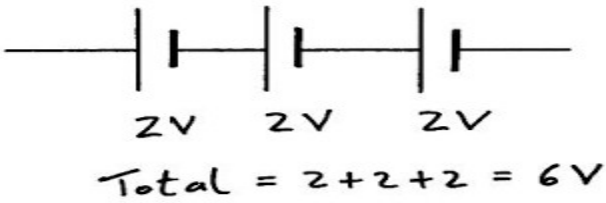
Resistors are said to be in series when they are connected end to end such that;

1. They have the same current flowing through each resistor.
2. Different voltage or potential difference (p.d) drops on each resistor.

## Cells Connected in a Series

Cells are said to be connected in series if the positive terminal of the first cell is connected to the negative terminal of the second cell, and the negative terminal of the second cell is connected to the positive terminal of the third cell. The same current flows through each cell.

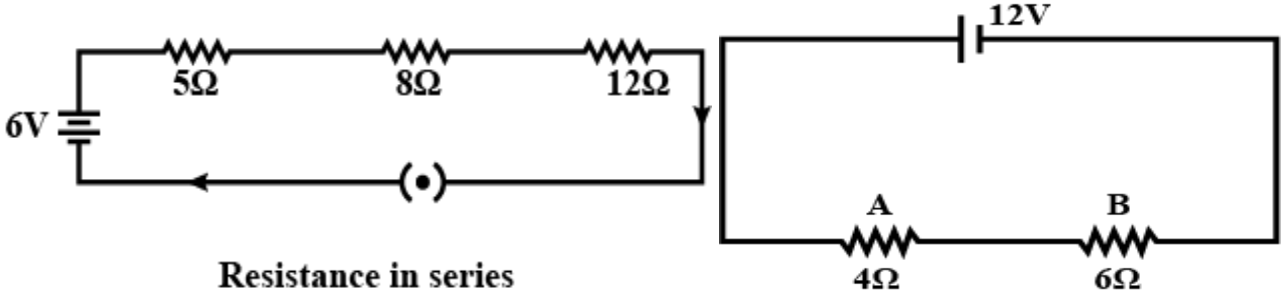



Total Voltage, $\mathbf{V= V_1 + V_2 + V_3}$ **……**

## Resistors in Series

Two or more resistors are said to be connected in series when the same amount of current flows through all the resistors. In such circuits, the voltage across each resistor is different. In a series connection, if any resistor is broken or a fault occurs, then the entire circuit is turned off.




Total resistance, $R_T=R_1+R_2+R_3$

$R_T$= 5+8+12

=25 ohms

$R_T=R_1+R_2+R_3$

$R_T$=4+6

=10ohms

**NB.** *When resistors are connected in series there increase in resistance so it effect on bulb light will make the bulb light dim.*

## Parallel Arrangement

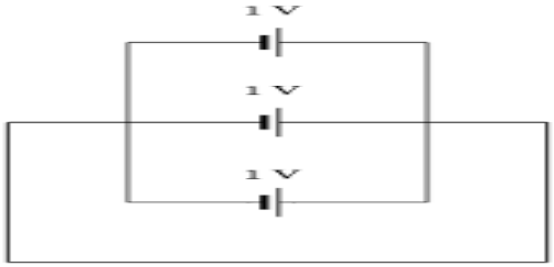
In a parallel circuit, electrical energy splits up and flows through different paths, like a group of people splitting up and taking different routes. This means that the current is divided among the different branches of the circuit

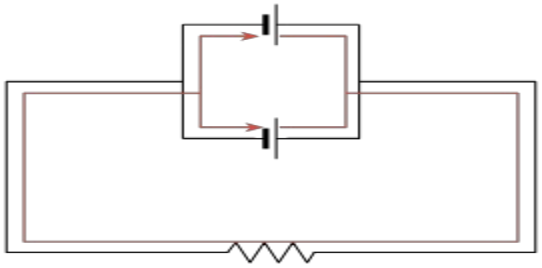
Resistors are said to be in parallel when they are arranged or connected end to end such that;

1. Different current flows through each resistor.
2. Same voltage drops on each resistor.

## Cells in parallel

When cells are connected in parallel, the total voltage across the combination remains the same as that of a single cell, but the overall current capacity increases. This means that the combination can deliver a higher total current compared to a single cell, making it suitable for applications requiring higher current output.



The total voltage = the voltage of one the cell. $V_T = V_1$ OR $V_T = V_2$

$V_T = V_1$

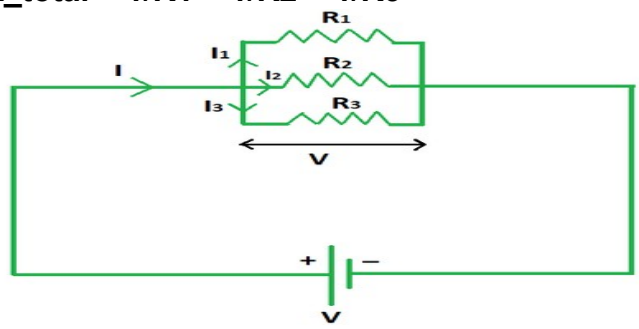
$V_T = 1volt$

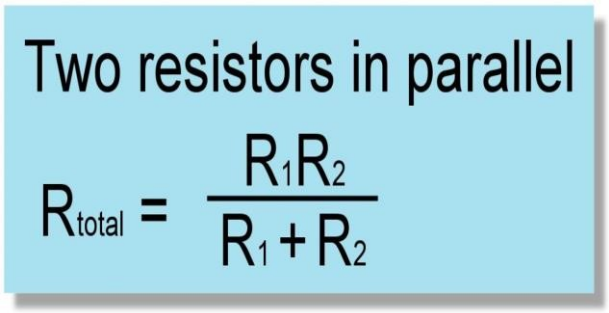
**NB.** *The total voltage across the circuit remains the same as that of a single cell*

## Resistors in parallel

The total resistance of resistors connected in parallel is calculated differently than resistors in series. For resistors in parallel, the reciprocal of the total resistance (R_total) is equal to the sum of the reciprocals of the individual resistances (R1, R2, R3, etc.). The formula for calculating total resistance in a parallel circuit with two resistors is:

**1/R_total = 1/R1 + 1/R2 + 1/R3**




**NB.** *When resistors are in parallel there is decreases in resistance so it effect on bulb will make the bulb light brighter.*

***B9.4.2.2.1 Describe Forward Bias and Reverse Bias and explain the relationship among the components, such as: leds, Diodes, Resistors and Capacitors, in an electronic circuit.***

## Formation of diode

Diodes are formed from a doped semi-conductor when joined n-type and p-type semiconductors.

**Semi-conductor.** This is a material whose electrical conductivity lies between a conductor and insulator. E.g. Silicon, germanium etc.

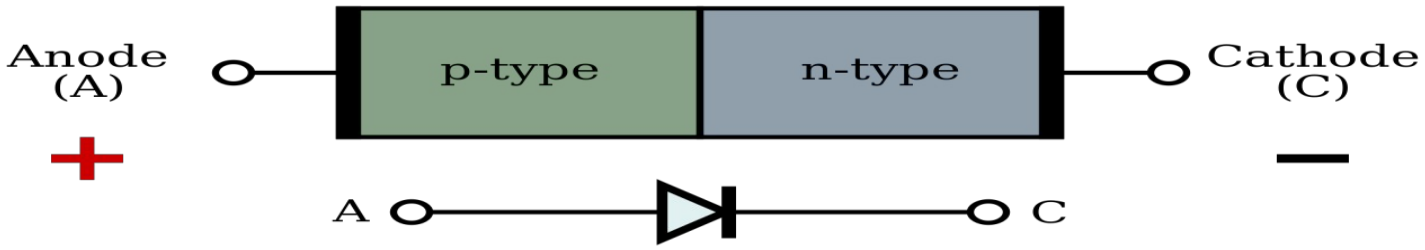
**Doping** This is a processing of adding impurities or foreign material to a semi-conductor in order to improve its electrical conductivity..

- **N-type semi-conductor.** This is an semi-conductor doped with **pentavalent impurities** where free **electrons are the majority** charge carries and **holes are minority** charge carries.
- **P-type semi-conductor.** This is extrinsic semi-conductor doped **with trivalent impurities** where **holes are majority** charge carries and **electrons are the minority** charge carriers.

**Difference between N-type and P-type semi-conductor**

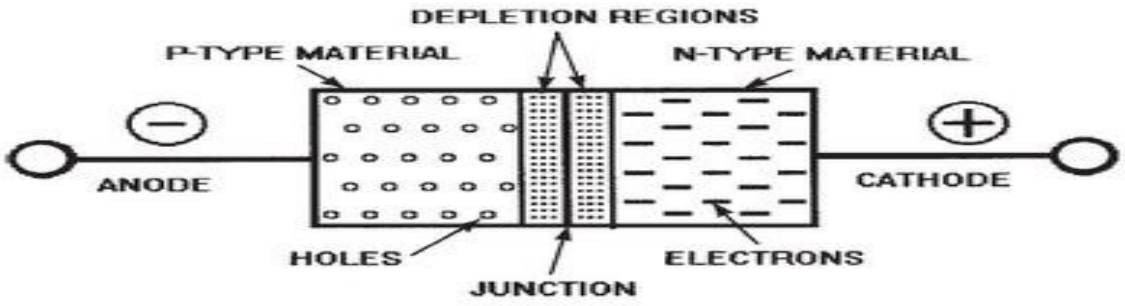
| N-type semi-conductor | P-type semi-conductor |
|---|---|
| The impurity is pentavalent element | The impurity is trivalent |
| The majority charge carrier are electrons | The majority charge carrier are holes |
| Electrical conductivity is much higher | The electrical conductivity is high. |

# P-N Junction diode

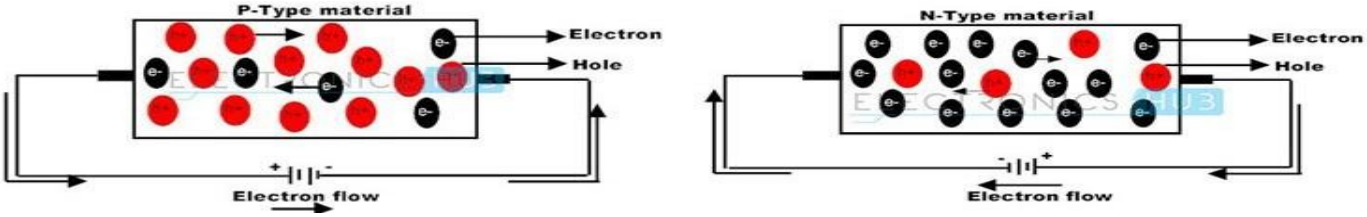



## Formation of p-n junction diode

**P-n junctions** are formed by joining n-type and p-type semiconductors.
The formation of a PN junction diode involves the coming together of two types of semiconductor materials: P-type (positively doped) and N-type (negatively doped). Here's a step-by-step explanation of how a PN junction diode is formed:
1. Start with Semiconductor Material: The process begins with a semiconductor material such as silicon or germanium, which has four valence electrons.
2. Doping: To create the P-type region, a trivalent impurity (such as boron) is added to the semiconductor material. This trivalent impurity has three valence electrons, creating "holes" in the crystal lattice where an electron is missing.
3. Doping for N-type Region: To create the N-type region, a pentavalent impurity (such as phosphorus) is added to the semiconductor material. This pentavalent impurity has five valence electrons, resulting in an extra electron available for conduction.
4. Diffusion: The P-type and N-type regions are created separately on the same semiconductor crystal. Through a process called diffusion or ion implantation, the dopants diffuse into the semiconductor material to create the P and N regions.
5. Formation of PN Junction: The P-type and N-type regions are brought into contact, forming what is known as a PN junction. At the junction, free electrons from the N-type region migrate to fill the "holes" in the P-type region, creating a depletion region with no mobile charge carriers.
6. Barrier Potential: Due to the migration of charges at the junction, an electric field is established across the depletion region, creating a potential difference known as the barrier potential.




*Semiconductor Electronics, P and N Type Semiconductors, P and N Channel Doping*



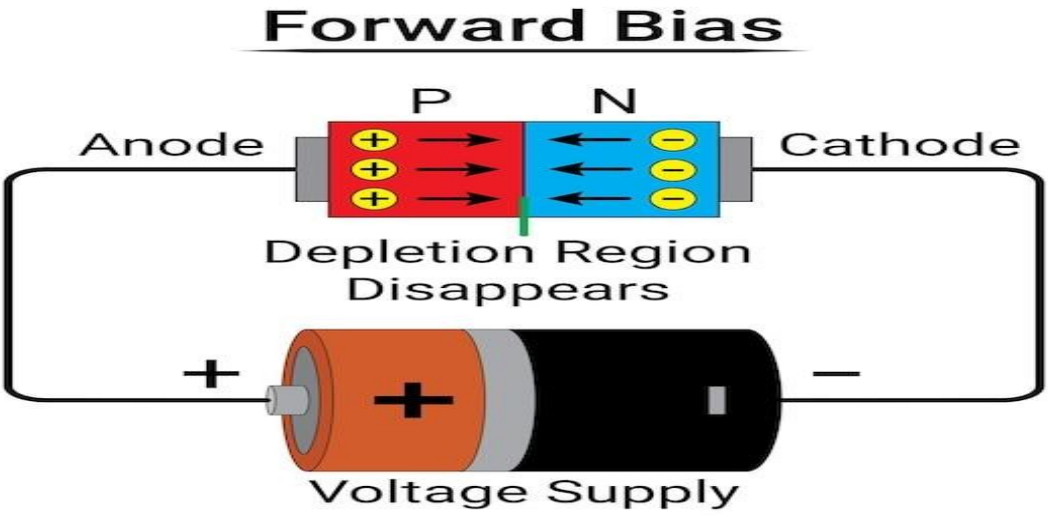
**Biasing**. *This is the process of adding direct current or voltage to a P-N junction diode to conduct electricity.* This is usually done by connecting a source of Emf across the p-n junction.

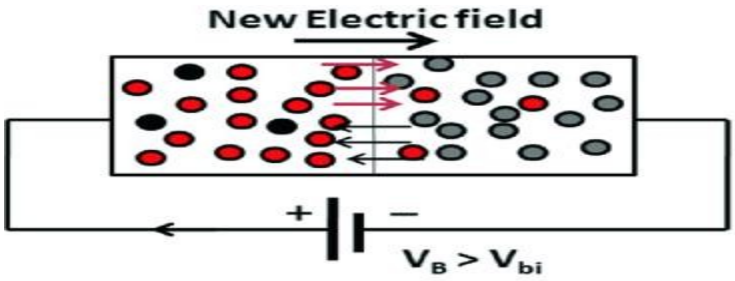
**Ways of biasing p-n junction**

1. **Forward biased**

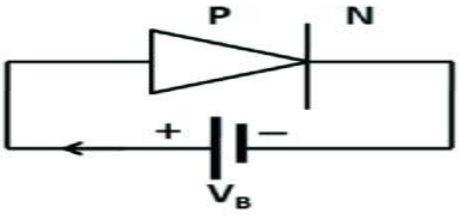
A p-n junction is said to be forward biased by connecting **the p-type semiconductor of a diode to the positive terminal** of a cell and **the n-type to the negative terminal** of the cell.

**Circuit diagram showing forward biasing**




Flow of drift current of majority carriers
(a)




Circuit diagram for forward biased p-n junction
(b)

**To construct an electronic circuit with forward bias, you will need a power source (such as a battery), a resistor, and an LED (Light Emitting Diode). Here are the steps:**

1. Connect the positive terminal of the battery to one end of the resistor.
2. Connect the other end of the resistor to the positive (anode) terminal of the LED.
3. Connect the negative (cathode) terminal of the LED to the negative terminal of the battery.

**Observation in forward bias**

When the circuit is complete and the battery is connected, *the LED should light up*. This is because the forward bias allows current to flow through the LED, **causing it to emit light.**

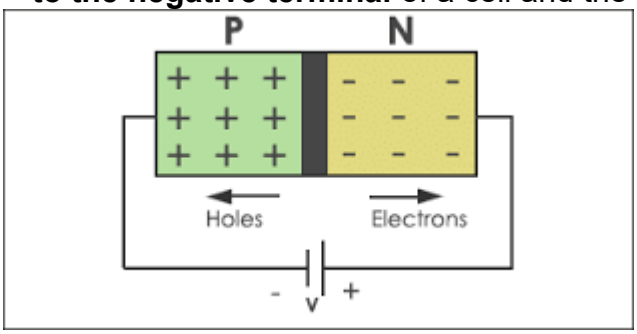
**The behaviour of a p-n junction diode when it is forward biased.**

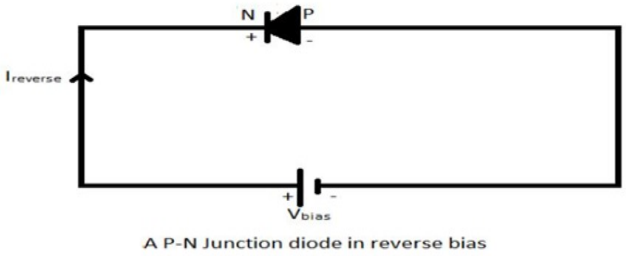
- ✓ The junction narrows

- ✓ Holes moves across the junction to the n-type material or electrons move in the opposite direction into the p-type material.
- ✓ Much more current flows in the circuit.

**2. Reversed biased**

A p-n junction is said to be reversed biased by connecting the **p-type semiconductor of a diode to the negative terminal** of a cell and the **n-type to the positive terminal** of the cell




A P-N Junction diode in reverse bias

*When you construct electronic circuits with reverse bias, it means that you are applying a* ***voltage in the opposite direction to the normal flow of current. In the case of an LED (Light Emitting Diode), if you apply reverse bias, it typically does not emit light. Instead, it acts as a diode and blocks the flow of current. So, when you observe an LED with reverse bias, you will usually see it turned off or not emitting any light.***

**NB. No Light Emission: In a reverse biased state, a regular PN junction diode does not emit light since there is no significant electron-hole recombination happening within the device**

**<u>Junction diode</u>**

This is a p-n junction used to rectify AC to DC

**<u>Uses of p-n junction diode</u>**

- ➢ It uses a rectifier
- ➢ It is used as voltage stabilizers
- ➢ It is used as modulators in frequency modulation.

**Electrical Rectification**

This is the conversion of alternating current (A.C) to direct current (D.C).

**<u>NOTE</u>** When you construct electronic circuits involving resistors and capacitors, and observe what happens to the LED, it will depend on the specific circuit configuration. The resistors and capacitors can affect the current and voltage in the circuit, which in turn can impact the behavior of the LED.

For example, if you have a simple RC circuit with a resistor and a capacitor connected in series, and you apply a voltage across the circuit, the capacitor will charge up over time. During this charging process, the LED may initially light up, but as the capacitor reaches its maximum charge, the LED may start to dim or turn off.

On the other hand, if you have a circuit with a resistor and capacitor connected in parallel, and you apply a voltage across the circuit, the capacitor will discharge through the resistor. In this case, the LED may not light up at all or may only emit a very dim light, depending on the values of the resistor and capacitor.

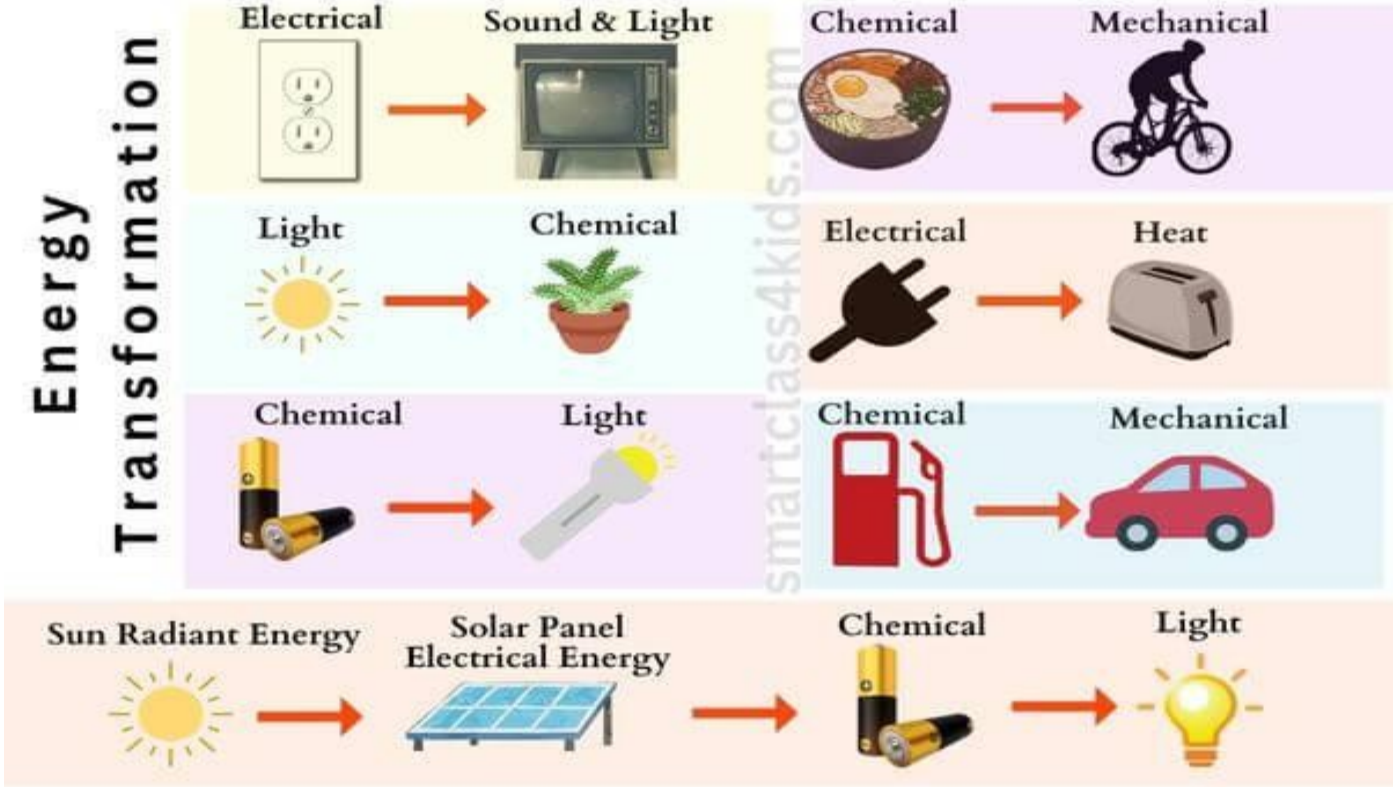
## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 3: CONVERSION AND CONSERVATION OF ENERGY
### B9.4.3.1.1. Describe how energy can be converted from one form to another and show how conservation of energy occurs

Energy can be converted from one form to another through various processes.
One common example is the conversion of electrical energy into light energy in the case of an LED.

***When an electric current flows through the LED, it excites the electrons in the semiconductor material, causing them to release energy in the form of light.***

Conservation of energy refers to the principle that energy cannot be created or destroyed, but only transformed from one form to another. This principle is upheld in various energy conversions. For example, when electrical energy is converted into light energy in an LED, the total amount of energy remains constant. Some of the electrical energy is transformed into light energy, while the rest may be dissipated as heat.

Energy can be converted from one form to another through various processes***. The principle of conservation of energy states that energy cannot be created or destroyed, but it can be transformed from one form to another.***
Here are some more examples of how energy can be converted from one form to another:




1. **Mechanical to Electrical Energy**: When you pedal a bicycle, the mechanical energy from your legs is converted into electrical energy by a dynamo, which powers the bicycle's lights.

2. **Chemical to Thermal Energy:** Burning wood in a fireplace converts the chemical energy stored in the wood into thermal energy in the form of heat and light.

3. **Nuclear to Electrical Energy:** Nuclear power plants use nuclear reactions to generate heat, which is then used to produce steam. The steam drives turbines, which in turn generate electrical energy.

4. **Solar to Electrical Energy:** Solar panels convert sunlight (solar energy) into electrical energy through the photovoltaic effect. The photons in sunlight excite electrons in the solar cells, creating an electric current.

5. **Wind to Mechanical Energy:** Wind turbines convert the kinetic energy of the wind into mechanical energy. The rotating blades of the turbine turn a generator, which produces electrical energy.

## Conversion of energy

**Conversion of energy** refers to the process of changing energy from one form to another. This can occur in various ways, such as converting mechanical energy into electrical energy in a generator, or converting chemical energy into thermal energy during combustion. The law of conservation of energy states that energy cannot be created or destroyed, only transferred or transformed from one form to another.

*The application of conversion of energy can be seen in our daily lives. For example, when we use a microwave to heat our food, electrical energy is converted into thermal energy. Similarly, when we turn on a light bulb, electrical energy is converted into light energy. These are just a few examples of how energy conversion is applied in our everyday activities.*

## Conservation of energy

**Conservation of energy** refers to the principle that the total amount of energy in a closed system remains constant over time. This means that energy is conserved and does not disappear or appear out of nowhere. It can only be transferred or transformed within the system.

*The application of conservation of energy is crucial in various aspects of life. For instance, in the field of environmental conservation, understanding the conservation of energy helps us make informed decisions about energy usage and reduce our carbon footprint. In engineering and design, conserving energy is important for creating energy-efficient systems and devices. Additionally, in physics and other scientific fields, the conservation of energy is a fundamental principle used to analyze and understand various phenomena.*

### ***Some more applications of conservation of energy:***

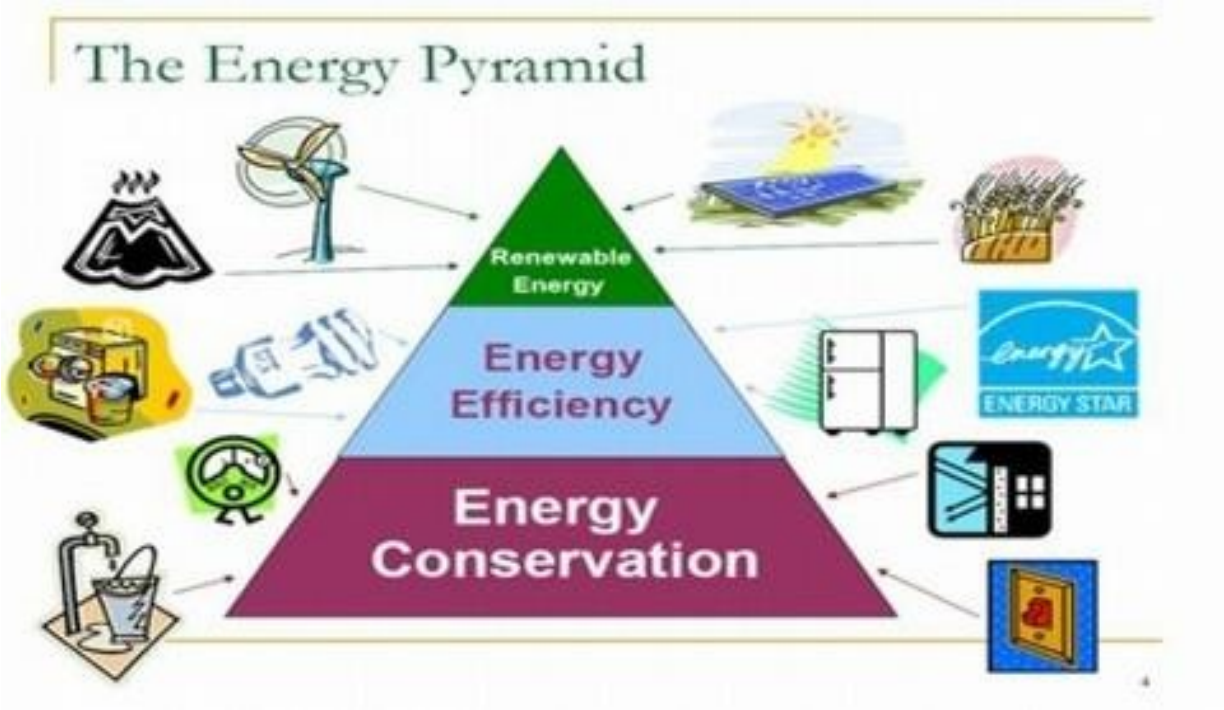
**1. Renewable Energy:** The conservation of energy principle is essential in the development and utilization of renewable energy sources such as solar, wind, and hydroelectric power. By harnessing these sources, we can generate electricity without depleting finite resources and minimize environmental impact.

**2. Energy Efficiency:** The concept of conserving energy is crucial in promoting energy efficiency. This involves using energy-saving technologies and practices to reduce energy consumption while maintaining the same level of output or comfort. Energy-efficient appliances, insulation, and smart home systems are examples of how conservation of energy is applied to improve efficiency.

**3. Transportation:** Conservation of energy plays a role in transportation systems. For instance, hybrid and electric vehicles utilize regenerative braking, which converts kinetic energy into electrical energy, thus conserving energy that would otherwise be wasted as heat during braking.

**4. Building Design**: Architects and engineers incorporate energy conservation principles into building design to minimize energy consumption. This includes using insulation, efficient lighting systems, and passive design strategies to reduce the need for heating, cooling, and artificial lighting.

**5. Industrial Processes**: Conservation of energy is applied in industrial processes to optimize energy usage and reduce waste. For example, heat recovery systems can capture and reuse waste heat generated during manufacturing processes, improving overall energy efficiency.




***B9. 4.3.1.2 Describe how conversion and conservation of energy are applied in life***

There are several opportunities to conserve energy in our daily lives. Here are a few examples:

1. Use energy-efficient appliances: Look for appliances with the Energy Star label, as they are designed to use less energy.

2. Unplug electronics when not in use: Many devices continue to consume energy even when they are turned off. Unplugging them can help save energy.

3. Adjust thermostat settings: Lowering the thermostat in winter and raising it in summer can help reduce energy consumption for heating and cooling.

4. Use natural lighting: Open curtains and blinds during the day to make use of natural light instead of relying on artificial lighting.

5. Switch to LED bulbs: LED bulbs are more energy-efficient and last longer than traditional incandescent bulbs.

6. Insulate your home: Proper insulation can help maintain a comfortable temperature inside your home, reducing the need for heating or cooling.

7. Use power strips: Plug multiple devices into a power strip and turn it off when not in use to prevent standby power consumption.
8. Optimize water usage: Fix leaks, take shorter showers, and use water-efficient appliances to reduce energy used for heating water

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 4: FORCE AND MOTION

**B9.4.4.1.1. Explain the concept of pressure and show pressure relates to force; perform activities that work on the principles of pressure in daily lives of humans.**

**Pressure** is the force exerted on a surface per unit area. It is typically measured in units such as pascals (Pa). Pressure can be caused by various factors, such as

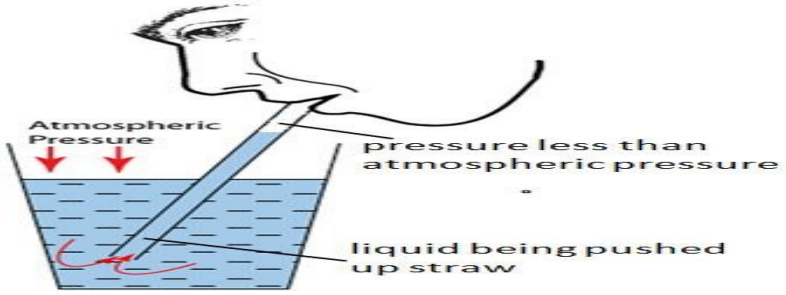
- The weight of a fluid or gas,
- The force applied by an object.

**Preasure = force /area., the SI unit is Pascal(Pa) or $N/m^2$**

1. A force of 150150 N is being applied over an area measuring 0.50.5 $m^2$. Calculate the pressure on the object ensuring you give the correct units.
To calculate the pressure on the object, you can use the formula:
Pressure = Force / Area
Plugging in the given values:
Force = 150 N
Area = 0.5 $m^2$
Pressure = 150 N / 0.5 $m^2$
Pressure = 300 $N/m^2$

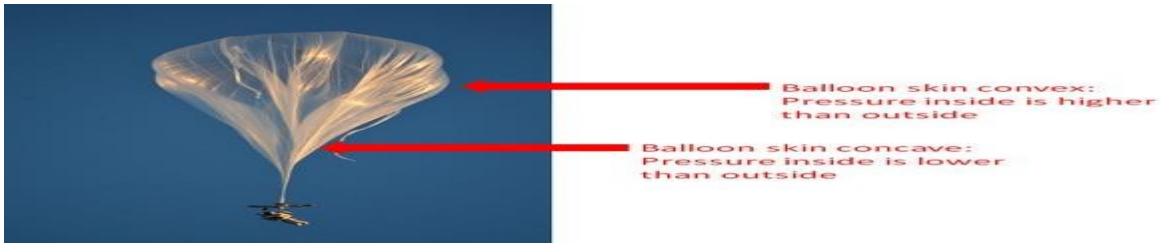
**The action of pressure through a number of activities such as drinking straw, Pumping car tyres, Filling of balloons, Water jet at washing bays, to understand the concept of pressure**

1. **Drinking straw:** When you suck on a straw, you create a low-pressure area inside the straw. This lower pressure causes the liquid to rise up the straw and into your mouth. The higher atmospheric pressure outside the straw pushes the liquid up to balance the pressure difference.




2. **Pumping car tires**: When you pump air into a car tire, the air molecules inside the tire become more compressed. This increase in the number of air molecules in a given volume creates a higher pressure inside the tire. The higher pressure pushes against the tire walls, making them firm and able to support the weight of the car.

3. **Filling balloons:** When you blow air into a balloon, you are increasing the pressure inside the balloon. The higher pressure inside the balloon pushes against the elastic walls, causing the balloon to expand and become inflated.



4. **Water jet at washing bays:** In a washing bay, water is forced out of a nozzle at high pressure. This high-pressure water jet is created by a pump that increases the pressure of the water. The high-pressure water can then effectively remove dirt and grime from surfaces.

**The relationship between pressure and force can be described by the equation:**

Pressure = Force / Area

In this equation, *pressure is directly proportional to force and inversely proportional to the area over which the force is applied.* This means that if the force applied remains constant, increasing the area over which the force is distributed will result in a decrease in pressure.

Conversely, if the area remains constant, increasing the force applied will result in an increase in pressure.

In simpler terms, pressure is the amount of force exerted on a given area. So, the greater the force applied over a smaller area, the higher the pressure.

**Pressure in liquids**!

When a liquid is at rest, it exerts a force in all directions.

This is due to the weight of the liquid above it pressing down.

This pressure increases with depth because the weight of the liquid above increases.

**Factors determining pressure in liquid**

1. The density of the liquid
2. The height of the column of liquid

**Presure in liquid act equally in all direction**

**Aim of the experiment**

Experiment to demonstrate that pressure In liquid act equally in all direction.

**observation**

water springs through the hole  equally in all direction

**conclusion**

pressure exterd by the water is what caused it to spurt in all direction

**Pressure in liquid increase with depth**

**Aim of the experiment**

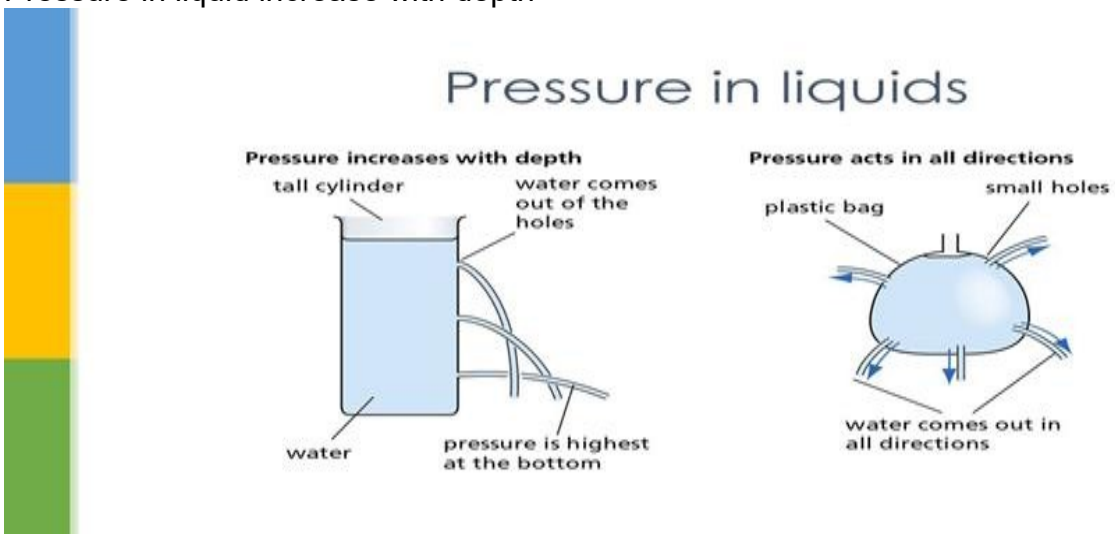
Experiment to demonstrate that pressure In liquid **increase with depth** .

**observation**

water springs from the three spring from different distances from the bottle.

**conclusion**

Pressure in liquid increase with depth



## *B9.4.4.1.1 Explain the importance of Newton's Third Law of motion in life*

**Newton's Laws of motion Law**

**1. Newton's First Law of Motion (Law of Inertia):** An object at rest will stay at rest, and an object in motion will stay in motion with the same speed and in the same direction unless acted upon by an external force.

**2. Newton's Second Law of Motion (Law of Acceleration):** The acceleration of an object is directly proportional to the net force applied to it and inversely proportional to its mass. This can be mathematically represented as F = ma, where F is the net force, m is the mass of the object, and a is the acceleration.

**3. Newton's Third Law of Motion (Law of Action and Reaction):** For every action, there is an equal and opposite reaction. This means that whenever an object exerts a force on another object, the second object exerts an equal and opposite force on the first object.

**Newton's Third Law of Motion**

**Newton's third law of *motion*** *states that for every action, there is an equal and opposite reaction.*

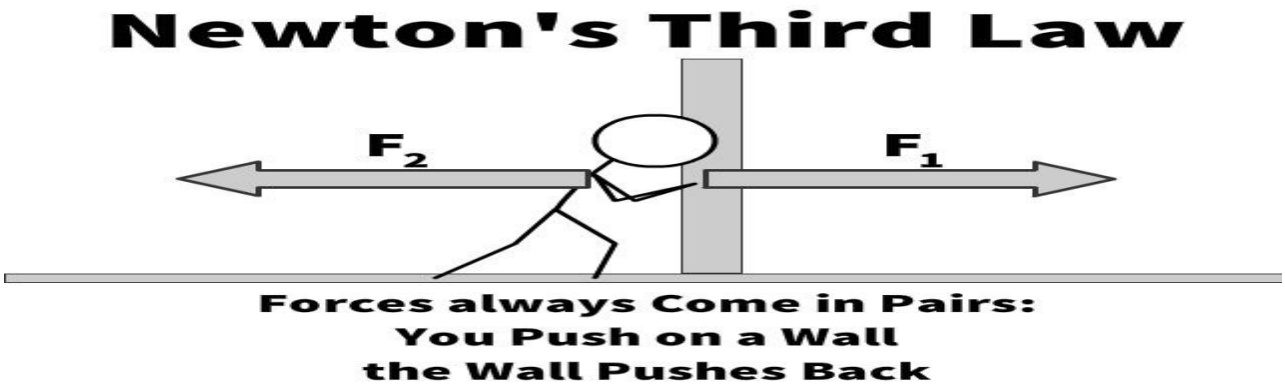
This means that whenever an object exerts a force on another object, the second object exerts a force of equal magnitude but in the opposite direction on the first object.
To understand this law, let's consider an example. If you push a wall with a certain force, according to Newton's third law, the wall pushes back on you with an equal force in the opposite direction. This is why you feel resistance when you push against a solid object.
The law applies to all types of forces, whether they are contact forces (like pushing or pulling) or non-contact forces (like gravitational or electromagnetic forces). It helps us understand how forces interact and affect the motion of objects.
Newton's third law is crucial in analyzing the motion of objects in various scenarios. It allows us to predict the behavior of objects in collisions, understand the mechanics of propulsion systems like rockets, and design structures and vehicles that can withstand forces.
Overall*, Newton's third law of motion is a fundamental principle in physics that helps us comprehend the interactions between objects and the forces involved in their motion*.

**Action and Reaction Force**

Now, let's learn about two terms called Action and Reaction force, which are used in Newton's third law of motion.

**Action Force:** The initial outside force exerted on the body is called the action force.

**Reaction Force:** The force the body exerts to respond to the active force in the opposite direction is called reaction force.



**Some applications of Newton's Third Law of Motion include:**
1. Rocket propulsion: The principle of action and reaction is crucial in rocket propulsion. The force exerted by the exhaust gases in one direction propels the rocket in the opposite direction.
2. Swimming: When we swim, we push against the water with our arms and legs, and the water pushes back with an equal and opposite force, propelling us forward.
3. Walking or running: When we walk or run, our feet push against the ground, and the ground pushes back with an equal and opposite force, allowing us to move forward.
4. Balloon propulsion: When air is released from a balloon, the air pushes out in one direction, causing the balloon to move in the opposite direction.
5. Recoil of firearms: When a firearm is fired, the bullet is propelled forward, and the gun recoils backward due to the equal and opposite reaction force.
6. Bouncing of balls: When a ball hits a surface, it exerts a force on the surface, and the surface exerts an equal and opposite force, causing the ball to bounce back

**Important aspects of Newton's third law of motion in life**:
1. Safety: Understanding Newton's third law helps engineers design safer structures and vehicles. By considering the equal and opposite forces involved in collisions, they can create better safety features and reduce the risk of injury.
2. Sports and Athletics: Newton's third law is crucial in analyzing the forces involved in sports activities. It helps athletes understand how their actions generate reactions, allowing them to optimize their performance and technique.
3. Everyday Interactions: Newton's third law is at play in our daily lives. For example, when we walk, the force we exert on the ground propels us forward, while the ground exerts an equal and opposite force that pushes us back. This law helps us understand how objects interact with each other in various situations.
4. Rocket Propulsion: Newton's third law is the basis for rocket propulsion. The force exerted by the rocket's exhaust gases in one direction creates an equal and opposite force that propels the rocket forward. This law is essential in space exploration and satellite launches.

**B9.4.4.1.2. Demonstrate the application of Newton's third Law of motion in life.**

**Predict what happens when**
A. A force is exerted on objects
B. There's reaction from the objects
C. The force exerted is the same as the reaction of the objects

**A. When a force is exerted on objects**, it causes a change in their motion or shape. The objects may accelerate, decelerate, or change direction depending on the magnitude and direction of the force.

**B. When there is a reaction from the objects,** it means that they exert a force back in response to the applied force. This is known as Newton's third law of motion, which states that for every action, there is an equal and opposite reaction.

**C. When the force exerted on the objects** is the same as the reaction of the objects, it means that the forces are equal in magnitude but opposite in direction. This is in accordance with Newton's third law of motion. The objects will experience a balanced force, resulting in no net change in their motion or shape.

## STRAND 4: FORCES AND ENERGY
## SUB-STRAND 5: AGRICULTURAL TOOLS
### B9.4.5.1.1 Identify materials used in making simple agricultural tools

**Agricultural tools** *are devices or equipment that are specifically designed and used in farming and agricultural activities.*

These tools help farmers in various tasks such as planting, cultivating, harvesting, and maintaining crops. Some common examples of agricultural tools include plows, tractors, seeders, harvesters, irrigation systems, and pruning shears.


**Agricultural tools are made from a variety of materials depending on their purpose and design.**
Some common materials used to make agricultural tools include:

**1. Steel**: Steel is a commonly used material for making agricultural tools due to its strength and durability. It is used in the construction of plows, shovels, hoes, and other hand tools.

**2. Iron:** Iron is another material used in the manufacturing of agricultural tools. It is often used for making parts of machinery like tractor components and tillage equipment.

**3. Wood:** Wood is used for making handles of tools such as hammers, axes, and shovels. It provides a comfortable grip and is relatively lightweight.

**4. Aluminum:** Aluminum is a lightweight metal that is used in the construction of certain agricultural tools like ladders, sprayers, and some parts of machinery.

**5. Plastic:** Plastic is used in the manufacturing of various agricultural tools, especially those that require resistance to corrosion and chemicals. Examples include irrigation pipes, seed trays, and some hand tools.

**The processes involved in making simple agricultural tools can vary depending on the specific tool, but here are some general steps:**

**1. Design:** The first step is to come up with a design for the agricultural tool. This involves considering the purpose of the tool and its intended use.

**2. Material selection:** Once the design is finalized, the next step is to select the appropriate materials for the tool. This can include metals, wood, or other materials depending on the tool's requirements.

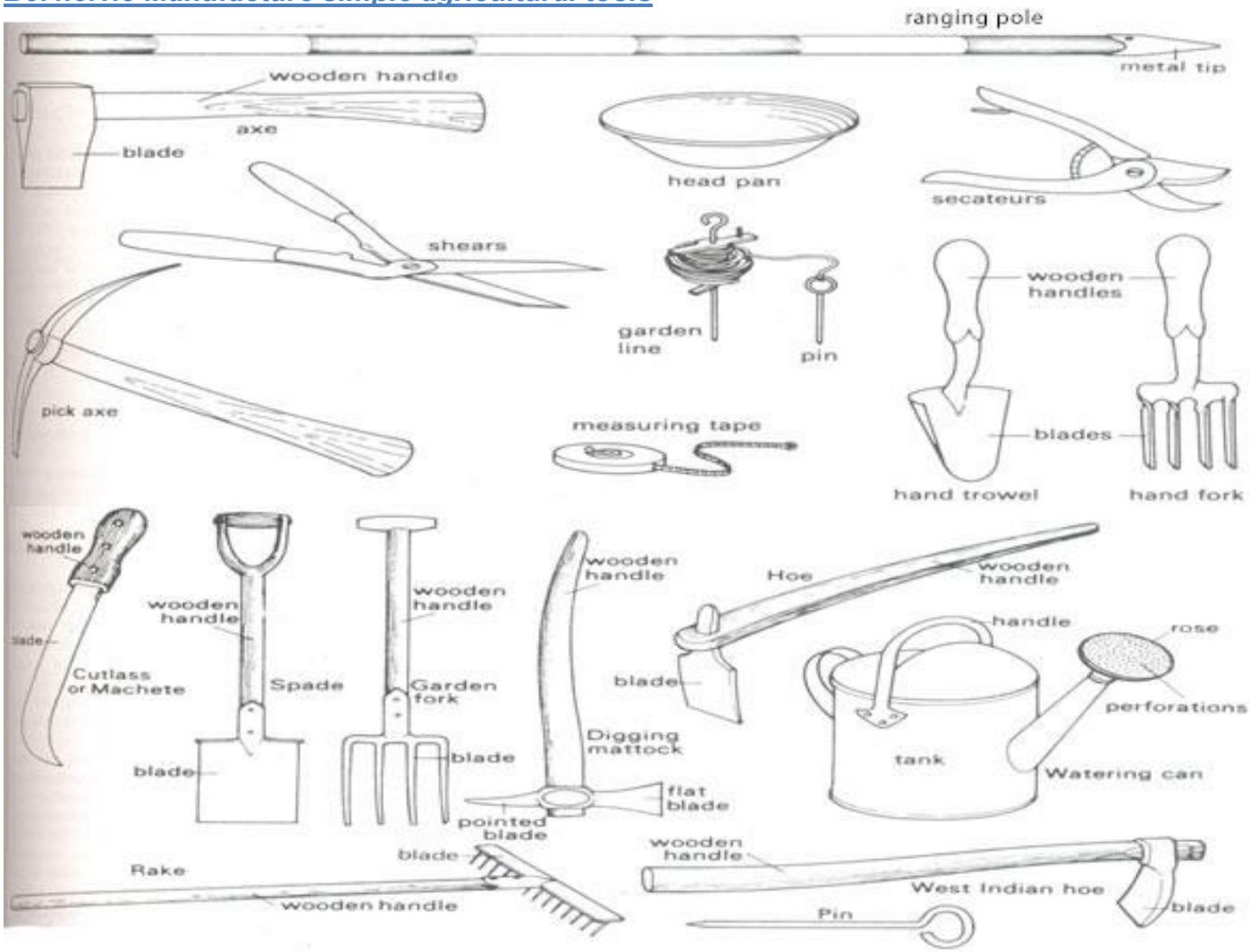
**3. Cutting and shaping:** The selected materials are then cut and shaped according to the design. This can involve using tools such as saws, drills, or lathes to achieve the desired shape and size.

**4. Joining:** If the tool requires multiple parts, they may need to be joined together. This can be done through welding, riveting, or other methods of fastening.

**5. Finishing:** After the tool is assembled, it may need to be finished to improve its appearance and functionality. This can involve processes such as sanding, polishing, or painting.

**6. Testing:** Before the tool is ready for use, it should be tested to ensure it functions properly. This can involve checking for any defects or weaknesses and making any necessary adjustments.
***It's important to note that the specific processes involved can vary depending on the tool and the resources available***.

## *B9.4.5.1.3 Manufacture simple agricultural tools*



**Ways to maintain farm tools:**

1. Clean the tools after each use.
2. Store the tools in a dry and secure place.
3. Regularly inspect the tools for any signs of damage or wear.
4. Sharpen the cutting edges of the tools when necessary.
5. Lubricate the moving parts of the tools to prevent rust and ensure smooth operation.

**Reasons why maintaining farm tools is important:**

1. Extends the lifespan of the tools.
2. Ensures efficient and effective use of the tools.
3. Reduces the risk of accidents or injuries.
4. Saves money by avoiding frequent replacements.
5. Improves overall productivity on the farm.

**Precautions to be taken when manufacturing simple agricultural tools,**

1. Use safe materials that won't break easily.
2. Be careful and follow the rules to avoid getting hurt.
3. Measure everything correctly so the tools work well.
4. Test the tools to make sure they are good before giving them to others.
5. Make sure the tools are made the right way according to the rules.

**The dangers of the misuse of agricultural tools.**

1. Personal injury
2. Damage to crops or livestock
3. Decreased productivity
4. Financial losses

## Test your mind

1. Axes and machetes are ..... Tools.
(a) cutting (b) clearing
(c) watering (d) transporting

2. …… has toothed bars fixed diagonally to a handle.
(a) Rake (b) File
(c) Trowel (d) Spade

3. Trowel is a ..... Tool.
(a) sharpening (b) transplanting
(c) cutting (d) none of these

4. Wheelbarrow is a ..... Tool.
(a) transplanting (b) transporting
(c) digging d) Sharpening

5. ..... Is a sharpening tool.
(a) Spade (b) Trowel
(c) File (d) Machete

6. State whether the following statements are true or false :
A. Tools make our job easier.
B. Digging and cutting tools should be kept sharp regularly.
C. Tools must be handled with care.
D. Agricultural tools must be stored in a damped room.
E. One must wear a mask while spraying insecticides.

7. Much the following :

| Column A | Column B |
|---|---|
| 1. Hoe | (a) Watering tool |
| 2. Rake | (b) Transporting tool |
| 3Axe | (c) Digging tool |
| 4. Tractor | (d) Leveling soil |
| 5. Watering can | (e) Cutting tool |

**Answer the following questions briefly :**

1. What are agricultural tools?
2. List some common agricultural tools.
3. Write the uses of the following tools:
(a) Hoe
(b) Rake
(c) Spraying pump
(d) Trowel
4. Write some methods of maintenance of agricultural tools.
5. Explain the dangers of the misuse of agricultural tools.

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 1: WASTE MANAGEMENT
### *B9. 5.1.1.1 Investigate the scientific methods used in waste management*

**Scientific underlying methods used in waste management**

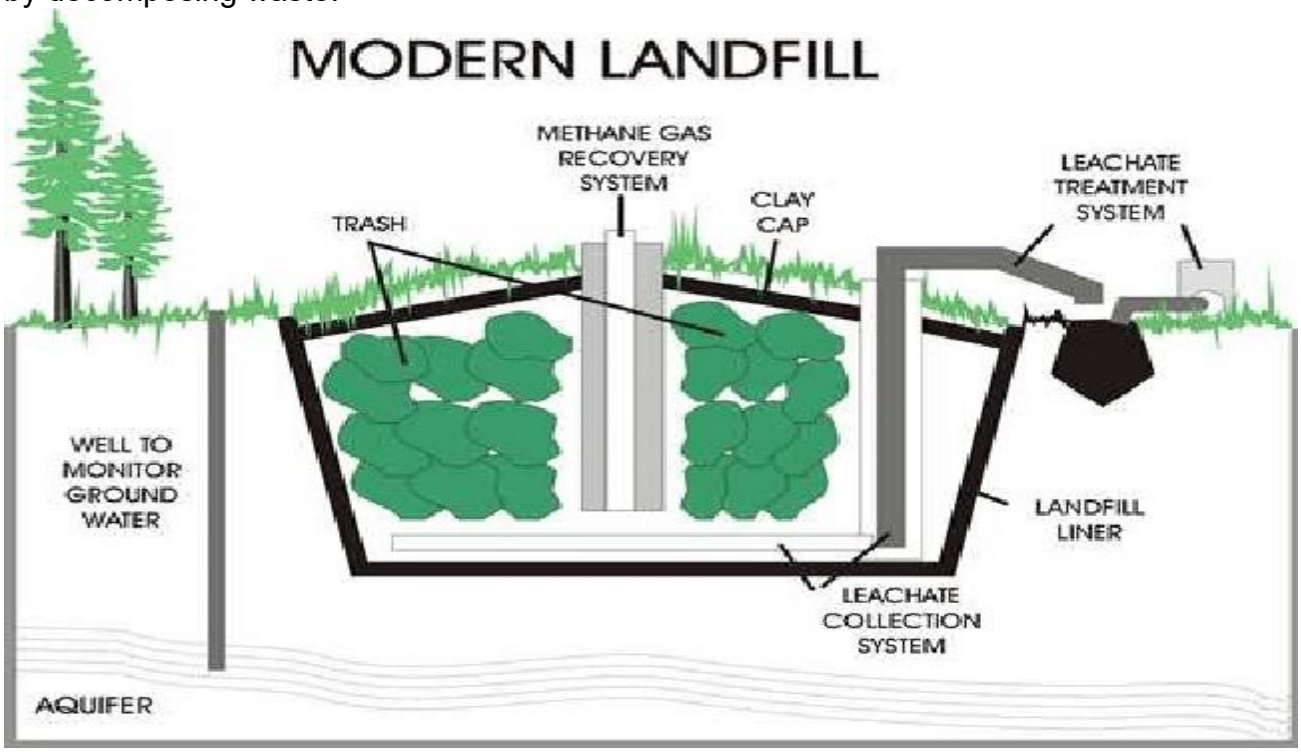
The scientific underlying method used in waste management is known as the 3Rs: **Reduce, Reuse, and Recycle.** ***This method focuses on minimizing waste generation by reducing the amount of waste produced, reusing items whenever possible, and recycling materials to create new products***. Additionally, waste management also involves proper disposal methods such as landfilling, incineration, and composting.
Some common methods include:

**1. Landfill:** This is the most common method of waste disposal, where waste is buried in designated areas called landfills. The waste is compacted and covered with soil to minimize odor and prevent contamination of groundwater.

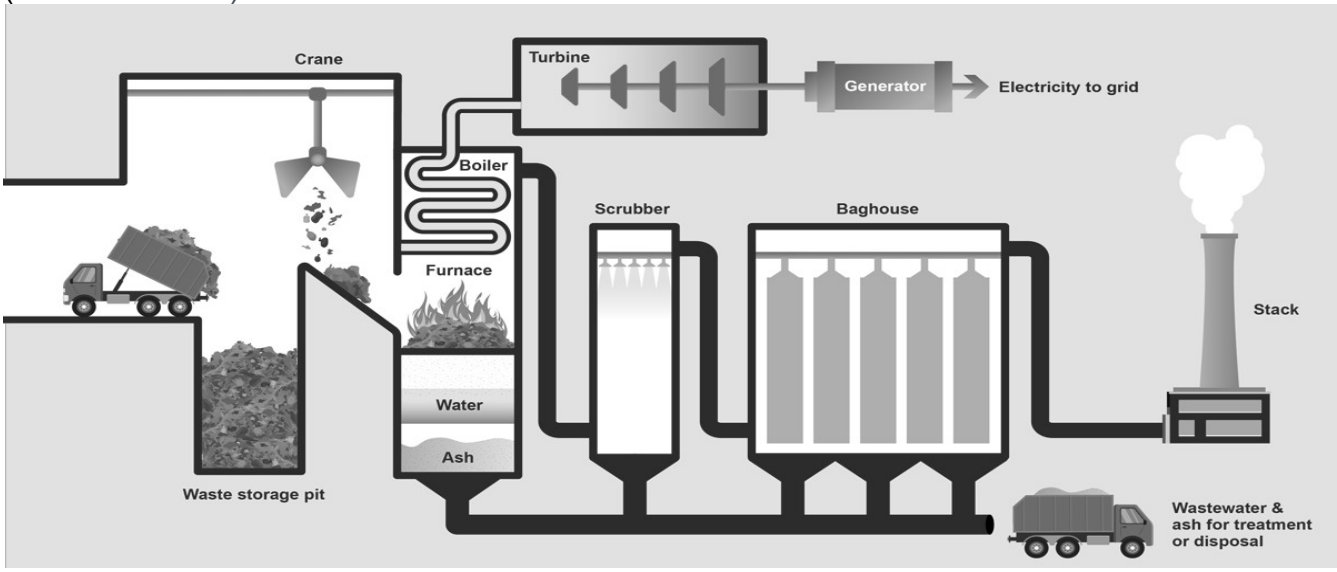
The method used in landfills is called "landfilling." It involves the disposal of waste materials by burying them in designated areas of land. The waste is compacted and covered with layers of soil to minimize odor, prevent the spread of diseases, and reduce the impact on the environment.

**Landfills play an important role in waste management and environmental protection**. Here are a few reasons why landfills are important:

- Landfills help keep our environment clean by providing a designated place for waste to be disposed of.
- Landfills prevent pollution by containing and isolating harmful materials from seeping into the soil and water sources.
- Landfills help control the spread of diseases by safely containing and managing waste that could attract pests and bacteria.
- Landfills conserve space by compacting waste, allowing us to use land more efficiently.
- Landfills can generate energy through the process of capturing and utilizing methane gas produced by decomposing waste.



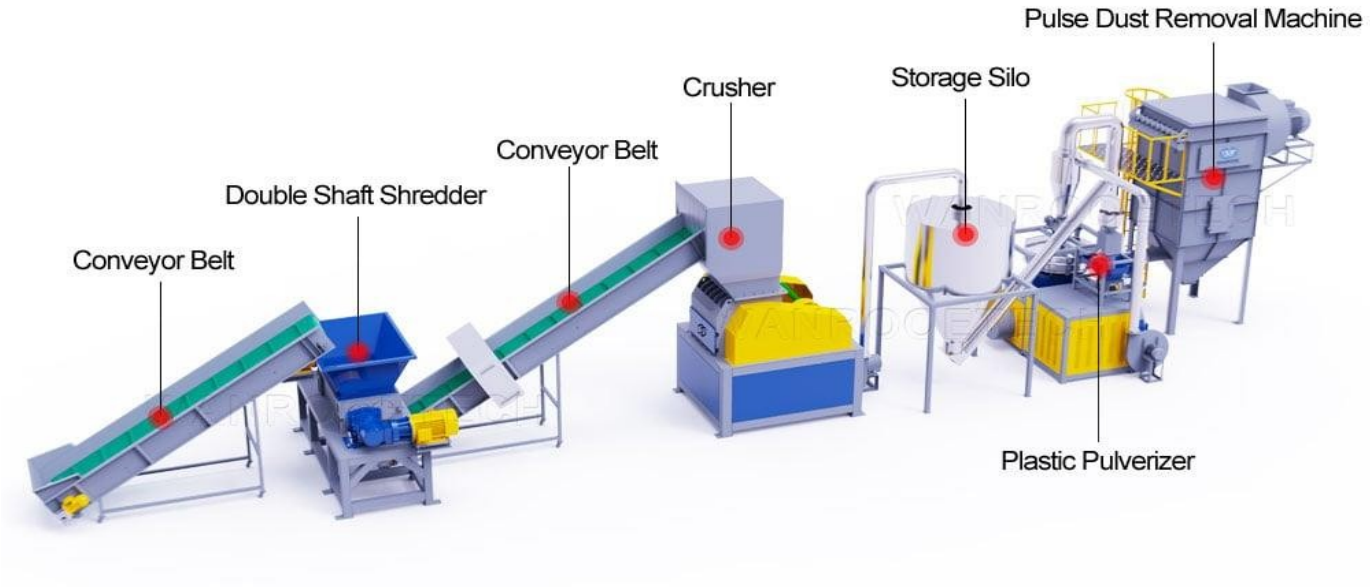
**2. Incineration**: This method involves burning waste at high temperatures. Incineration can reduce the volume of waste and generate energy in the form of heat or electricity. However, it can also release pollutants into the air if not properly controlled. This method usually take place in furnace (heater or boiler).




**Importance of incineration used in waste management**

f) Incineration helps reduce the volume of waste by burning it, making more space available in landfills.
g) Incineration can generate electricity by using the heat produced from burning waste.
h) Incineration helps destroy harmful substances and pathogens that may be present in the waste.
i) Incineration can be a more environmentally friendly option compared to landfilling, as it reduces the release of greenhouse gases.
j) Incineration can help reduce the need for fossil fuels by using waste as a source of energy.

**3. Recycling**: Recycling involves the collection and processing of waste materials to create new products. This method helps conserve resources, reduce energy consumption, and minimize the amount of waste sent to landfills.



**The plastic recycling process steps**

**1. Collection:** Plastic waste is collected from various sources such as households, businesses, and recycling centers.
**2. Sorting:** The collected plastic waste is sorted based on its type and quality. This helps in separating different types of plastics for recycling.
**3. Shredding:** The sorted plastic waste is then shredded into small pieces to increase its surface area and facilitate further processing.
**4. Washing:** The shredded plastic pieces are thoroughly washed to remove any contaminants such as dirt, labels, or residue.
**5. Melting:** The cleaned plastic pieces are melted down to form a molten plastic material.
**6. Extrusion or Molding:** The molten plastic is then either extruded through a die to form plastic pellets or molded into specific shapes using molds.
**7. Manufacturing:** The plastic pellets or molded shapes are used as raw materials in the manufacturing of new plastic products.

**Processes involved in recycling of paper**

**1. Collection :** Paper waste is collected from various sources such as households, offices, and recycling centers...
**2. Sorting**: The collected paper is sorted based on its type, quality, and color. This helps in ensuring that only suitable paper is used for recycling.
**3. Shredding:** The sorted paper is then shredded into small pieces to increase its surface area and make it easier to process.
**4. Pulping**: The shredded paper is mixed with water and chemicals to create a pulp. The chemicals help break down the paper fibers and remove any ink or contaminants.
**5. Cleaning:** The pulp is cleaned to remove any remaining impurities, such as staples or plastic.
**6. Deinking:** In this step, the pulp is treated with chemicals and mechanical processes to remove ink and other coatings from the paper fibers.
**7. Refining**: The cleaned and deinked pulp is refined to improve its quality and strength.
**8. Forming:** The refined pulp is then formed into new paper sheets using various techniques, such as pressing and drying.
**9. Finishing:** The newly formed paper sheets may undergo additional processes, such as coating or calendaring, to enhance their properties.
**10. Distribution**: The recycled paper is then packaged and distributed to be used in various applications, such as printing, packaging, or manufacturing.

**Important reasons why recycling is significant:**

f. Recycling helps save natural resources by turning old materials into new ones.
g. Recycling reduces the amount of waste that goes to landfills, helping to protect the environment.
h. Recycling saves energy because it takes less energy to make products from recycled materials compared to using raw materials.
i. Recycling helps reduce pollution by reducing the need for extracting, refining, and processing raw materials.
j. Recycling creates jobs in industries that collect, process, and manufacture recycled materials.

**4. Composting**: Composting is the process of decomposing organic waste, such as food scraps and yard waste, into nutrient-rich soil. This method is environmentally friendly and can be used for agricultural purposes.

**Compost** is a type of organic matter that is created through the decomposition of various organic materials, such as food scraps, yard waste, and other biodegradable materials. It is a natural process where microorganisms break down the organic matter, resulting in a nutrient-rich soil amendment. Compost is commonly used in gardening and agriculture to improve soil quality, retain moisture, and

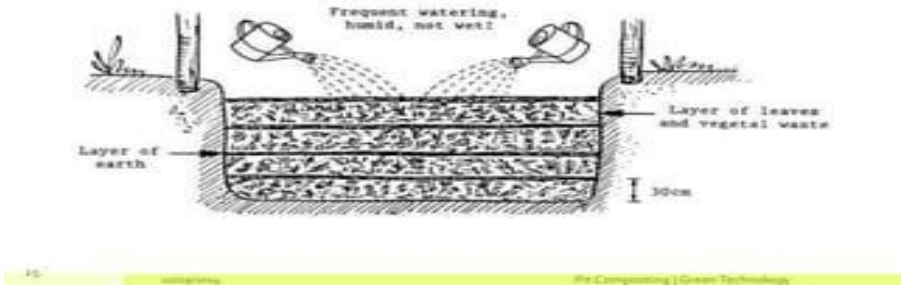
provide essential nutrients for plants. It is an environmentally friendly way to recycle organic waste and reduce the need for chemical fertilizers.

**Starters.** Are materials that help kickstart the decomposition process in a compost pile. *They provide the necessary nutrients and microorganisms that break down organic matter into nutrient-rich compost.* Some common starters include fruit and vegetable scraps, coffee grounds, tea bags, and crushed eggshells.

**Methods of composting**

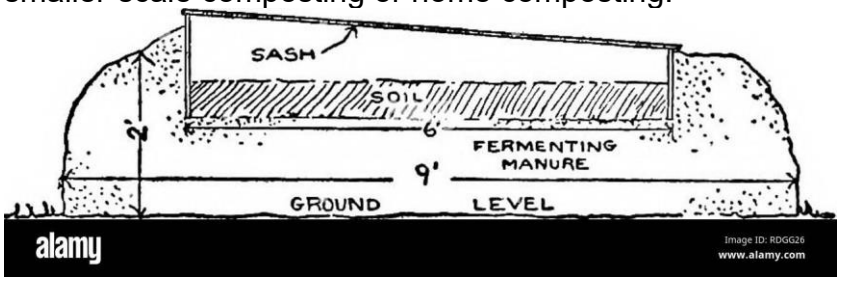
I. **Pit method**

Pit composting is a method of composting where organic materials are placed in a pit or hole in the ground. This method involves digging a pit or trench, usually about 1-2 feet deep, and filling it with a mixture of organic waste, such as food scraps, yard waste, and other biodegradable materials. The pit is then covered with soil or a layer of straw to help retain moisture and promote decomposition




**Ii. Stack or Heap methods**

The heap method of composting involves creating a large pile or heap of compost materials. This method requires less maintenance and turning compared to the stack method. It is commonly used for smaller-scale composting or home composting.




**Organic materials that can be added to the compost**

1. Cut grass
2. Leaves
3. Maize stover
4. Lawn chippings
5. Animal manure

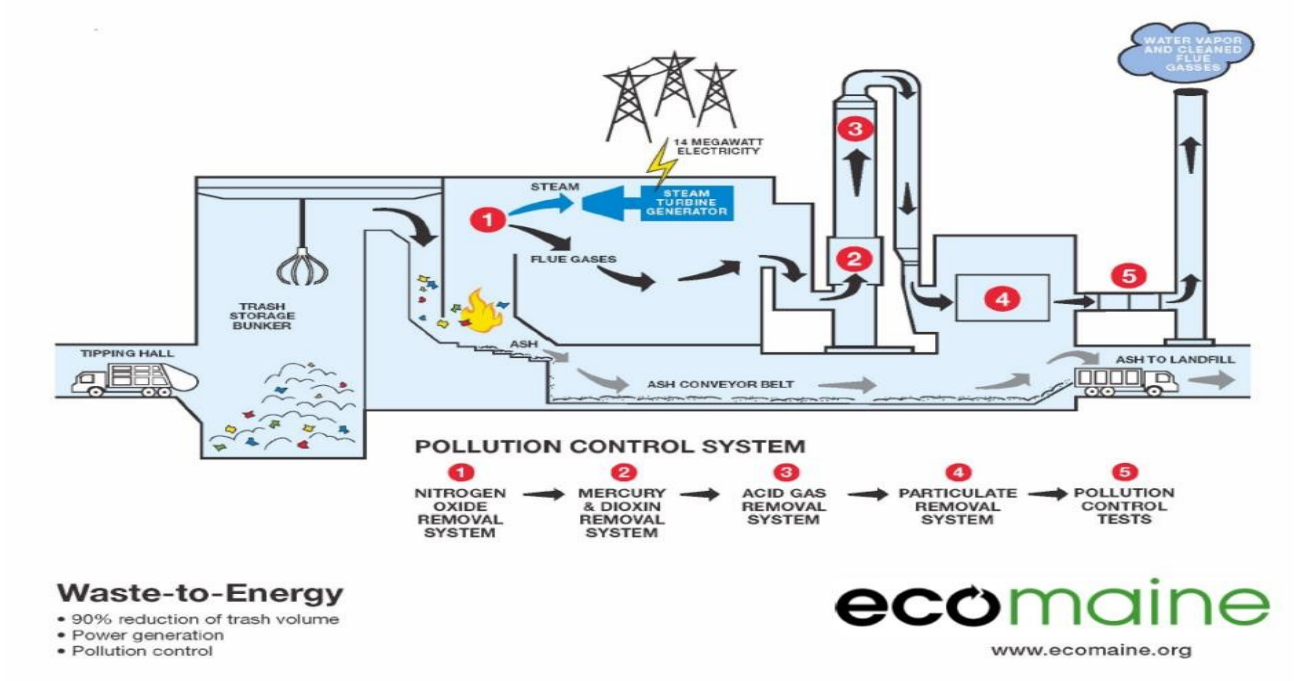
**Principles involved in composting**

1. Site selection
2. Gathering of compost materials
3. Waste management
4. Aeration the compost
5. Monitoring the compost
6. Include starters

**Importance of composting**

1. Reduces waste
2. Decreases greenhouse gas emissions
3. Improves soil fertility
4. Retains moisture in the soil
5. Suppresses pests and weeds

**5. Waste-to-Energy**: This method involves converting waste into energy through various processes, such as anaerobic digestion or gasification. It helps reduce the reliance on fossil fuels and can generate electricity or heat.




**<u>The methods used in waste management are based on several scientific principles.</u>**
These scientific principles, along with various engineering and management practices, form the basis of modern waste management systems. Here are a few key principles underlying these methods:

**1. Source Reduction:** This principle focuses on minimizing waste generation at the source. It involves practices such as reducing packaging materials, using durable and reusable products, and promoting sustainable consumption patterns. By reducing the amount of waste produced, we can minimize the need for disposal and conserve resources.

**2. Recycling:** Recycling is based on the principle of converting waste materials into new products. It involves collecting, sorting, and processing recyclable materials such as paper, plastic, glass, and metal. Recycling helps conserve natural resources, reduce energy consumption, and decrease the amount of waste sent to landfills.

**3. Composting:** Composting is a natural process that converts organic waste, such as food scraps and yard trimmings, into nutrient-rich compost. This process is based on the principles of decomposition and nutrient cycling. Composting helps divert organic waste from landfills, reduces greenhouse gas emissions, and produces a valuable soil amendment for gardening and agriculture.

**4. Waste-to-Energy:** Waste-to-energy technologies are based on the principle of converting waste into usable energy. These methods include incineration, gasification, and anaerobic digestion. By harnessing the energy content of waste materials, we can generate electricity, heat, or biofuels, reducing the reliance on fossil fuels and minimizing the environmental impact of waste disposal.

**5. Landfilling:** Landfilling, as mentioned earlier, involves burying waste in designated areas. This method is based on principles of waste containment, compaction, and environmental protection. Landfills are designed to minimize the release of pollutants into the environment and prevent the contamination of soil and water resources.

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 2: HUMAN HEALTH
### *B9.5.2.1.1 Explain the symptoms, effects and prevention of common non- common communicable diseases and analyze the risk factors associated with them*

**Disease** is any disorder which interferes negatively with the normal functioning of the body of an organism.

**Health** is the complete physical, mental, and social-wellbeing of a person and not merely the absence of diseases and infirmities.

**Symptoms** are abnormal changes or signs in the body of a person which helps the doctor to identify a disease.

**Vector** is an agent which transmit a disease-causing organism to a person.

**Diseases can be group into two main types**

A. Infectious diseases
B. Non-infectious disease

**Infectious diseases**

**Infectious diseases**. These are diseases caused that are caused by micro-organisms. Example, viral, protozoan, fungi, bacterial and worm diseases.

**Types of Infectious diseases**

**A. Communicable** These are diseases which are can easily be transmitted from one organism to another through air. Eg common cold, TB, etc.

**B. Contagious diseases.** These are diseases transmitted through contact with an infected organism. Most viral diseases are contagious. Example, swine fever, influenza, cold etc.

**Terms associated with Pathogenic diseases**

- **Zoonotic diseases**. These are diseases that affect both humans and livestock (animals). Examples, rabies, anthrax and bird flu.
- **Epizootic diseases.** These are diseases that are prevalent only temporarily. Examples, red water and Heartwater.
- **Endemic diseases.** These are diseases that become prevalent in a particular community, area or geographical region on regular basis. Examples, trypanosomiasis and buruli ulcer.
- **A pandemic** is an epidemic that's spread over multiple countries or continents.
- **An epidemic** is a disease that affects a large number of people within a community, population or region.

**Non-communicable diseases**

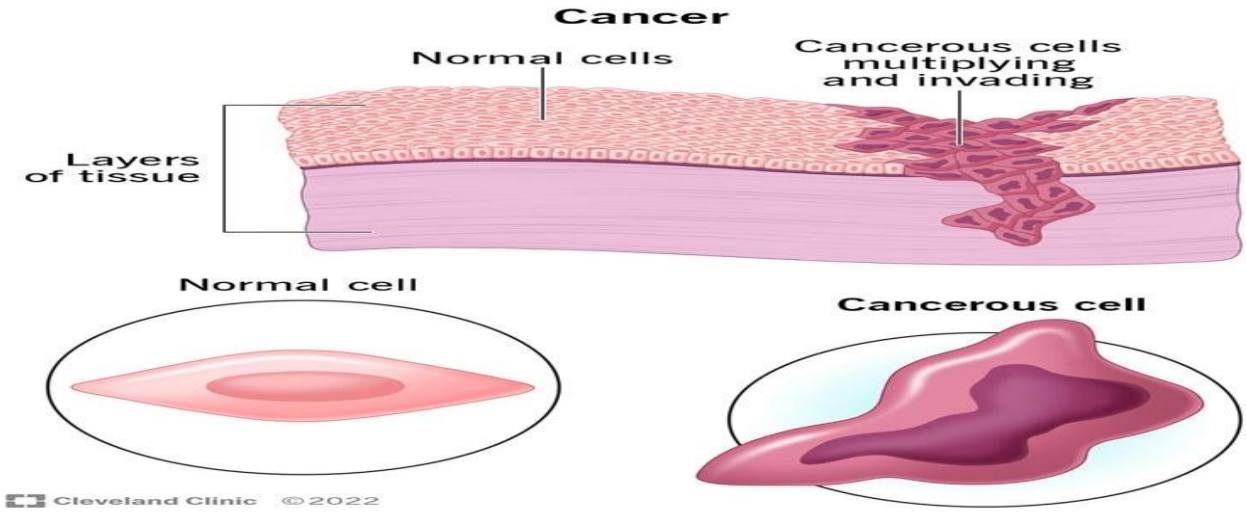
**Non-communicable diseases, also known as chronic diseases,** *are medical conditions that are not caused by infectious agents and cannot be transmitted from person to person.*
These diseases typically develop over a long period of time and are often influenced by a combination of genetic, environmental, and lifestyle factors.

**1. Cardiovascular Disease:**
- Causes: High blood pressure, high cholesterol, smoking, obesity, and lack of physical activity.
- Symptoms: Chest pain, shortness of breath, fatigue, and irregular heartbeat.
- Effects: Increased risk of heart attack, stroke, and heart failure.

- Prevention: Regular exercise, healthy diet, avoiding smoking, managing stress, and regular check-ups.

**2. Diabetes:**
- Causes: Genetic factors, obesity, unhealthy diet, and lack of physical activity.
- Symptoms: Frequent urination, excessive thirst, unexplained weight loss, fatigue, and blurred vision.
- Effects: Increased risk of heart disease, kidney damage, nerve damage, and eye problems.
- Prevention: Maintaining a healthy weight, regular exercise, balanced diet, and regular blood sugar monitoring.

**3. Cancer:** It is a group of diseases involving abnormal cell growth with the potential to invade or spread to other parts of the body.




- **Causes:**
  - Genetic factors
  - Cigarette Smoking and Secondhand Smoke Exposure.
  - Exposure to Sun and Tanning Beds.
  - Overweight and Obesity.
  - Excessive Alcohol Use.
  - Infectious Disease.

- **Symptoms:** Vary depending on the type of cancer but can include
  - Unexplained weight loss
  - Fatigue
  - Pain
  - Changes in the skin
  - Abnormal bleeding.

- **Effects**: Can lead to the growth of abnormal cells that invade and destroy healthy tissues.

- **Prevention:**
  - Avoiding tobacco and excessive alcohol consumption
  - Maintaining a healthy weight
  - Regular exercise
  - Protecting against infections (e.g., HPV, hepatitis)

**Some common cancers that affect humans include**

- Breast cancer,
- Lung cancer,
- Colorectal cancer,
- Prostate cancer,
- And skin cancer

These cancers can have a significant impact on a person's life, both physically and emotionally. Treatment for cancer often involves a combination of surgery, chemotherapy, radiation therapy, and targeted therapy. It is important for individuals to undergo regular screenings and maintain a healthy lifestyle to reduce the risk of developing these cancers.

**4. Chronic Respiratory Diseases:**

- Causes: Smoking, exposure to air pollution, occupational hazards, and genetic factors.
- Symptoms: Shortness of breath, coughing, wheezing, chest tightness, and frequent respiratory infections.
- Effects: Reduced lung function, decreased quality of life, and increased risk of respiratory infections.
- Prevention: Avoiding smoking and exposure to secondhand smoke, reducing exposure to air pollution, regular exercise, and maintaining a healthy lifestyle.

***B9.5.2.2.1. Explain the nature of fungal diseases with emphasis on ringworm, candidiasis, fingernail, and toe nail infection, and their causes, symptoms, effects on humans and its preventions.***

***Fungal diseases*** **are** caused by various types of fungi that can infect different parts of the body.

**Fingernail and toenail infections**, also known as onychomycosis, are caused by different types of fungi, including dermatophytes and yeasts.

These infections can occur when fungi enter the nail bed through small cuts or separations between the nail and the skin.

Symptoms of nail infections include thickened, discolored, and brittle nails. In severe cases, the nails may become distorted or detached from the nail bed.


**Diseases caused by Fungi**

| Diseases | Causes (Causative agent) | Mode of transmission | Symptoms | Prevention or control |
|---|---|---|---|---|
| **Athlete's foot** | Tinea pedis | Contact with infected persons, contaminated baths and floor. | Fluid-filled blisters, presence of sudden peeling and cracked skin between toes | - Oral antibiotic<br>- Disinfection of communal baths and floors. |
| **Ringworm** | Tinea capitis | Direct contact (E.g. Combs, brushes, caps, hats) with contaminated objects or persons. | Small scaly ring-shaped sports or scalp with broken hair. | - Oral antibiotic<br>- Local application of fungicidal ointment.<br>- Avoid sharing of articles with infected persons specially combs, brushes, caps and hats. |
| **Thrush or Candidiasis** | Candida albicans | Fungus present in mouth and faces of most healthy people as a harmless commensal, infection arises due to reduction in resistance of body. | Inflamed skin in the mouth (oral thrush), vaginal of females (vaginal thrush) | - Drugs<br>- For more severe or systemic candidiasis infections, such as invasive candidiasis or candidemia, antifungal medications may be administered intravenously (IV) in a hospital setting. |
| **Fungal eye infections, or fungal keratitis** | Fusarium, Aspergillus, or Candida | These fungi can enter the eye through a scratch or injury to the cornea, or by using contaminated contact lenses or eye drops. | Redness, pain, blurred vision, sensitivity to light, excessive tearing, discharge from the eye, and the feeling of something in the eye. | - Good hygiene practices<br>- Properly cleaning and disinfecting contact lenses,<br>- Avoiding wearing contact lenses while swimming or in environments with high levels of dust or dirt. |

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 3: SCIENCE AND INDUSTRY
### *B9.5.3.1.1 Investigate the scientific concepts, principles and processes involved in industries in their environment*

**Science-related industries** *refer to industries that are involved in the application of scientific knowledge and principles to various fields.*
These industries typically focus on research, development, and production of products or services that are based on scientific advancements.

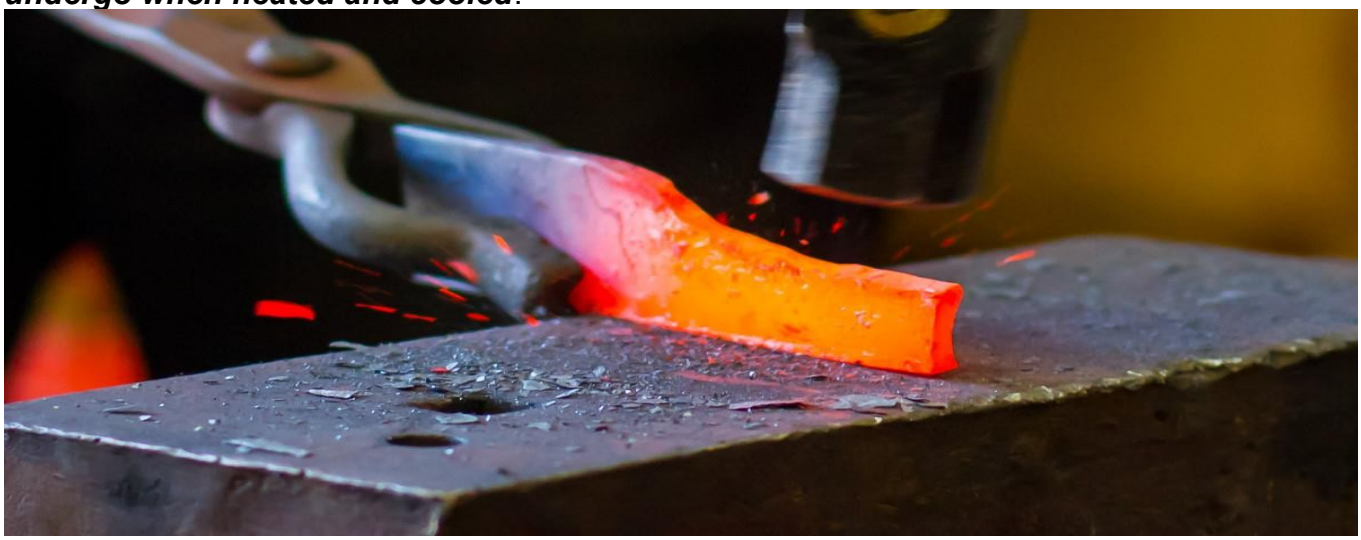
**Some examples of science-related industries include**

- Blacksmithing
- Gari processing
- Soap making
- Salt making
- Kenkey production
- Vegetable crop production
- Biogas production
- Fish making.

A. **Blacksmithing** is a traditional craft that involves shaping and forging metal using heat and tools. When metal is heated, it undergoes a process called annealing, which involves heating the metal to a specific temperature and then allowing it to cool slowly. This process helps to relieve internal stresses in the metal and make it more malleable for shaping. Another important principle in blacksmithing is the concept of forging.

*Forging* involves heating the metal to a high temperature, typically in a forge, and then shaping it using various tools such as hammers and anvils.

The heat softens the metal, making it easier to manipulate and shape. Quenching is another scientific principle used in blacksmithing. After shaping the metal, it is often cooled rapidly by immersing it in water or oil. This rapid cooling process, known as quenching, helps to harden the metal and improve its strength and durability. ***The scientific underlying principles of blacksmithing are primarily based on the properties of metals such metals are malleable and the physical changes they undergo when heated and cooled***.



B. **Gari processing** is a traditional method of processing cassava roots into a dry, granular product called gari. The scientific underlying principles of gari processing are primarily based on the enzymatic and chemical reactions that occur during the process.

1. The first step in gari processing is the peeling and washing of the cassava roots. This is done to remove the outer skin and any dirt or impurities. The scientific principle behind this step is the use of water to physically remove the outer layers of the cassava roots.

2. After peeling and washing, the cassava roots are grated or crushed to break down the cell walls and release the starch. This is where enzymatic reactions come into play. Cassava contains enzymes called amylases, which break down starch into smaller molecules called sugars. The scientific principle behind this step is the enzymatic hydrolysis of starch by amylases.

3. Once the cassava roots are grated or crushed, the resulting mash is then fermented. During fermentation, the sugars produced from the enzymatic reactions are converted into alcohol and carbon dioxide by yeast and bacteria. This fermentation process is essential for the production of gari and is based on the scientific principle of microbial metabolism.

4. After fermentation, the mash is then pressed to remove excess liquid. This is typically done using a hydraulic press or by placing the mash in a porous bag and applying pressure. The scientific principle behind this step is the separation of solids and liquids through mechanical force.

5. The final step in gari processing is the drying of the pressed mash. This is usually done by spreading the mash on large trays or mats and exposing it to sunlight or artificial heat. The scientific principle behind this step is the evaporation of moisture from the mash, resulting in the formation of dry granules.


**C. Soap making** is a process that involves combining fats or oils with an alkali, such as sodium hydroxide or potassium hydroxide. This mixture undergoes a chemical reaction called saponification, which results in the formation of soap.

The scientific principle behind soap making is that the alkali reacts with the fats or oils to break them down into glycerol and fatty acid molecules. These molecules then combine to form soap. The soap molecules have a hydrophilic (water-loving) head and a hydrophobic (water-repelling) tail, which allows them to interact with both water and oils, making them effective for cleaning.

***The scientific underlying principle behind soap making is the principle of saponification. Saponification is a type of chemical reaction known as a hydrolysis reaction, where a triglyceride (fat or oil) reacts with an alkali to form soap and glycerin***


Flow Diagram for Soap Production

**D. Salt making**, also known as salt production or salt harvesting, is the process of extracting salt from saltwater or salt deposits.

There are different methods of salt making, but the most common method is evaporation. In this process, saltwater is collected in large shallow ponds or pans and left to evaporate under the sun. As the water evaporates, the salt concentration increases until the salt crystallizes and can be harvested.
***The scientific principle behind salt making is the concept of evaporation.***

E. **Kenkey production**
Kenkey is a traditional Ghanaian dish made from fermented corn dough. It is typically served with a variety of sauces or stews and is a popular street food in Ghana. Kenkey is made by fermenting corn dough.
The corn dough is mixed with water and left to ferment for a period of time, usually overnight. After fermentation, the dough is wrapped in banana leaves or corn husks and boiled until cooked.

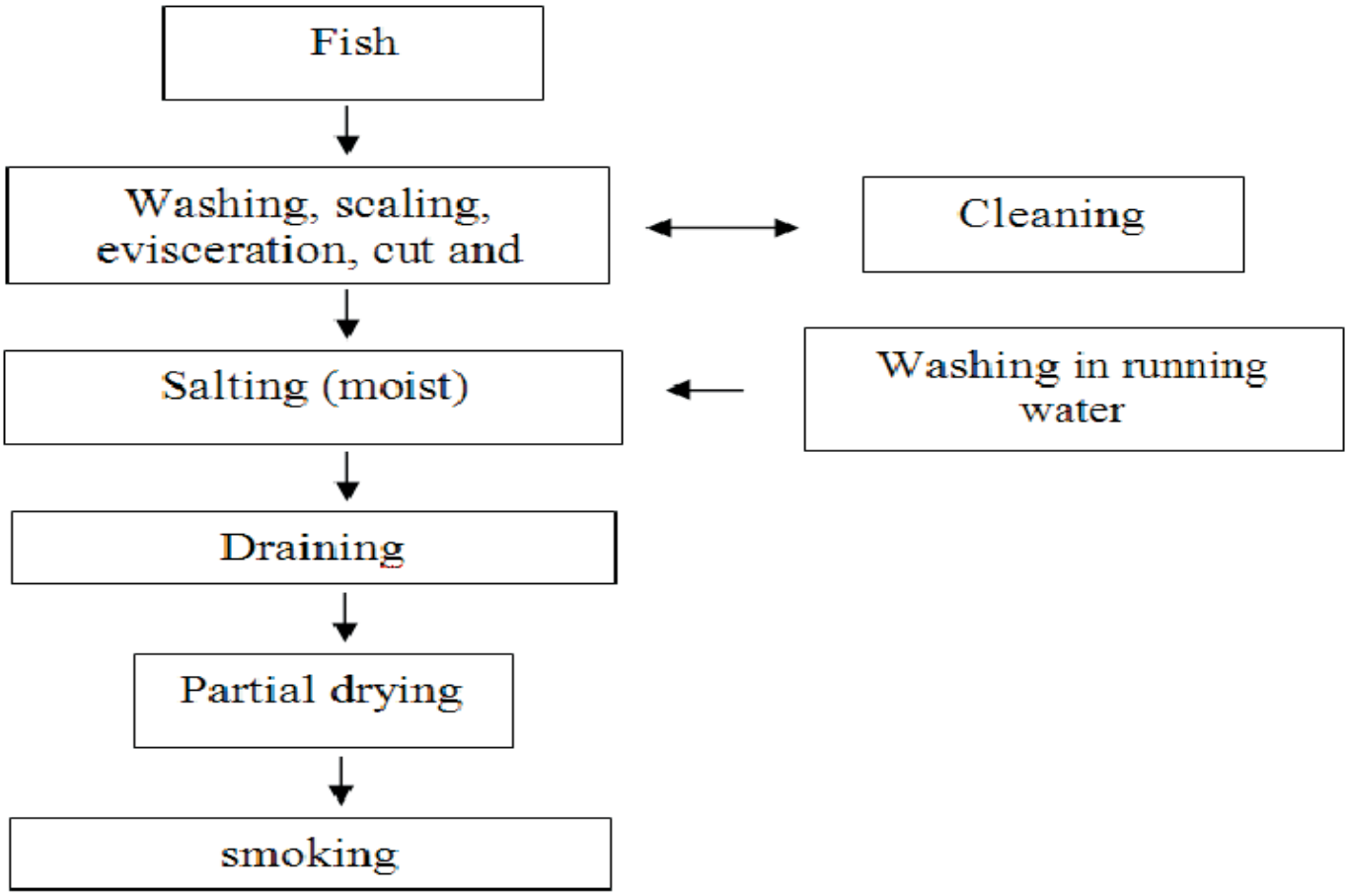
***The scientific underlying principle behind soap making is the principle of fermentation.***

**Figure 1: The Kenkey Production Process**

| Sinks | Sources |
|---|---|
| Corn washing | Wash water |
| Corn Steeping | Spent steep water |
| Dough making | |
| Cooking dough portion (aflata) | |
| Kenkey cooking (steaming) | |

**F. Fish smoking** is a method of preserving and flavoring fish. It involves exposing the fish to smoke from burning wood or other materials.

***The scientific underlying principles of fish smoking are primarily based on <u>extraction or evaporation</u> of water from a fish when it is exposed to heat.***.



***B9.5.3.1.1 Investigate the scientific concepts, principles and processes involved in industries in their environment***

**Scientific processes involve in the following local industries**

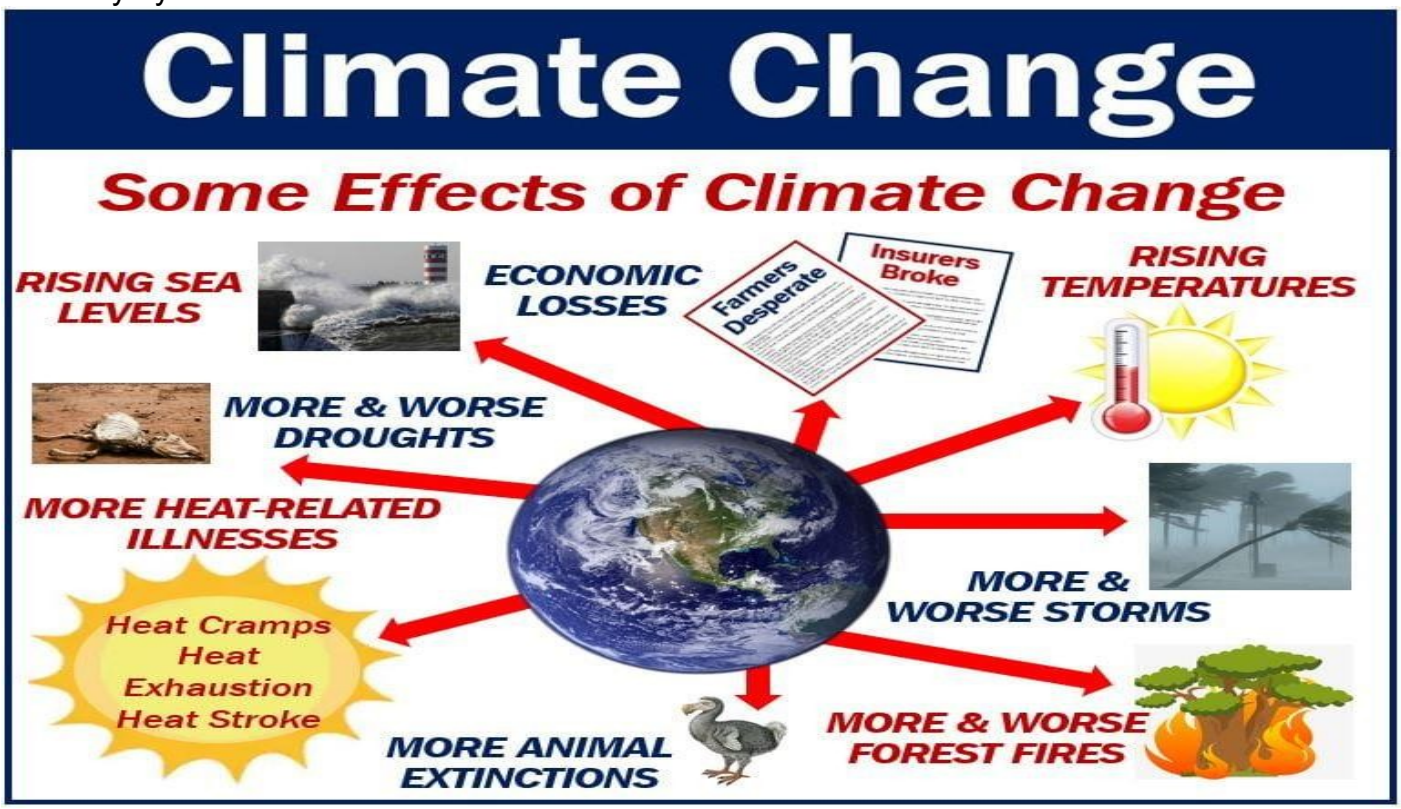
- Kenkey production – fermentation
- Soap production – saponification.
- Salt production – evaporation and crystallization
- Vegetable oil production – pressing
- Gari processing – fermentation.

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 4: CLIMATE CHANGE AND GREEN ECONOMY

**B9.5.4.1.1 Examine various natural and human factors that influence climate change and green economy in their localities**

**Climate:** is the condition of the atmosphere at a particular location over a long period of time. It is the long-term summation of the atmospheric elements and their variations.

**Climate change**: Is the long term changes to the climate of a region or country, or even the whole world.
The term climate change refers to significant changes in average weather patterns (i.e. Precipitation, temperature, wind and other indicators) that persist within a climate system, caused directly or indirectly by human activities.




**Human activities that influence climate change**

- Burning of fossil fuels
- Deforestation
- Industrial activities
- Mining
- Agricultural

**Natural factors that influence climate change.**

1. **Solar radiation:** Changes in the intensity of solar radiation reaching the Earth's surface can impact climate patterns. Variations in the Sun's energy output, such as solar flares or sunspot activity, can influence the Earth's temperature.

2. **Volcanic activity**: Volcanic eruptions release large amounts of gases and particles into the atmosphere. These volcanic emissions can affect climate by blocking sunlight and cooling the Earth's surface temporarily.

3. **Ocean currents**: Ocean currents play a crucial role in redistributing heat around the globe. Changes in ocean circulation patterns, such as El Niño and La Niña events, can impact regional and global climate patterns.

4. **Natural greenhouse gases:** Certain gases, such as carbon dioxide (CO2), methane (CH4), and water vapor, occur naturally in the atmosphere and contribute to the greenhouse effect. Changes in the concentrations of these gases can influence the Earth's climate.

**Effects of climate change on the Environment:**

1. Direct physical harm on humans
2. Crop failure and farmland loss
3. Sea level rises and coastal submersion
4. Freshwater loss and desertification

**Causes of uneven heating of the earth's surface**

- ✓ Curvature of the earth's surface or angle at which the sun's rays strike the earth or the earth is a sphere with the equator heated more intensely than the poles.
- ✓ Revolution of the earth around the sun.
- ✓ Difference in land and sea temperatures.
- ✓ Rotation of the earth on its axis.
- ✓ The earth covered primarily with two land and water which get heated and cool at different rates.

**Effects of climate change on biodiversity resources**

- ✓ It changes in vegetation patterns.
- ✓ Changes in plant life cycles
- ✓ Rising levels of sea
- ✓ Warmer oceans
- ✓ Changes in pattern of weather and rainfall.
- ✓ Air and water pollution
- ✓ Population displacement.

**There are several ways to minimize human activities that influence climate change.**

**1. Reduce greenhouse gas emissions**: One of the most effective ways to minimize human activities that contribute to climate change is to reduce greenhouse gas emissions. This can be done by transitioning to renewable energy sources, such as solar or wind power, and by improving energy efficiency in buildings, transportation, and industrial processes.

**2. Promote sustainable transportation:** Encouraging the use of public transportation, carpooling, cycling, and walking can help reduce carbon emissions from transportation. Additionally, supporting the development and adoption of electric vehicles can also contribute to minimizing the impact of human activities on climate change.

**3. Practice sustainable agriculture**: Implementing sustainable agricultural practices, such as organic farming, agroforestry, and precision farming techniques, can help reduce greenhouse gas emissions from the agricultural sector. These practices can also improve soil health and water conservation.

**4. Support reforestation and afforestation**: Planting trees and restoring forests can help absorb carbon dioxide from the atmosphere, as trees act as natural carbon sinks. Supporting initiatives that promote reforestation and afforestation can help mitigate the impact of human activities on climate change.

**The green economy**

*A green economy is one that aims to reduce environmental risks and ecological scarcities while promoting sustainable development*. It's low carbon, resource efficient, and socially inclusive. It involves activities and sectors that focus on reducing carbon emissions, conserving natural resources, and promoting clean and renewable energy sources. The green economy aims to balance economic growth with environmental sustainability.

**Ways we can practice green economy**:
1. Reduce, reuse, and recycle.
2. Use renewable energy sources.
3. Conserve water and energy.
4. Support sustainable agriculture.
5. Promote eco-friendly transportation.
6. Minimize waste generation.
7. Encourage green building practices.
8. Invest in green technologies.
9. Support local and sustainable businesses.
10. Advocate for environmental policies and regulations.

**Sustainable energy choices**.
*Sustainable energy choices are derived from resources that can maintain current operations without endangering future energy needs or the climate*. They include renewable sources like wind, solar, geothermal, and hydropower. These energy sources are often renewable, meaning they can be continuously replenished, unlike fossil fuels which are finite resources. *Among the discovered sustainable energy choices are; solar energy, wind energy, hydropower, geothermal energy and ocean energy.*

1. **Solar Energy:** Solar energy is derived by capturing radiant energy from the sun and convert it into electricity. Photovoltaic (PV) systems can convert direct sunlight into electricity through the use of solar cells. Benefits: One of the benefits of solar energy is that sunlight is always available. It improves public health and environmental conditions because there no release of greenhouse gases in the environment.

2. **Wind Energy:** Wind farms capture the energy of the wind by using turbines and converting it into electricity.

3. **Geothermal Energy:** Geothermal energy allows us to fetch energy from beneath the earth. This occurs by installing geothermal power stations that can use the heat coming out from inside the earth to generate electricity. Geothermal energy cannot be harnessed everywhere as high temperature is needed to produce steam that could move turbines. It can be harnessed in areas that have high seismic activity and are prone to volcanoes. They are environment friendly and can produce energy throughout the day but their ability to produce energy at suitable regions restricts us from using it on a much wider scale.

4. **Ocean Energy:** The waves or tides of the ocean have great power which can tapped can generate a lot of energy to power millions of homes. Waves produced at the oceans can be used by ocean thermal plants to convert the kinetic energy in waves to mechanical energy of turbines which can be converted to electrical energy through generators.

5. **Biomass Energy**: Bioenergy is a renewable energy derived from biomass. Biomass is organic matter that comes from living plants and organisms. Using wood in your fireplace is an example of biomass that most people are familiar with. There are various methods used to generate energy through the use of biomass.

6. **Hydroelectric Power:** There are the rivers or waterfalls whose energy of the moving water when captured that can turn turbines to generate power. This is commonly known as hydroelectric power. It is very common nowadays and it is powering most parts of the world especially Ghana, the Akosombo Dam.

**Ways we can practice sustainable energy choice:**

1. Use solar power.
2. Harness wind energy.
3. Utilize geothermal energy.
4. Invest in hydroelectric power.
5. Promote bioenergy sources.
6. Support tidal and wave energy.
7. Explore nuclear energy options.
8. Implement energy-efficient technologies.
9. Encourage the use of biomass energy.
10. Adopt sustainable heating and cooling systems.

## STRAND 5: HUMANS AND THE ENVIRONMENT
## SUB-STRAND 5: UNDERSTANDING THE ENVIRONMENT

**B9.5.5.1.1 Show and list the uses of different plant parts for agricultural and non-agricultural purposes.**

**Agricultural purpose** refers to activities or uses related to farming, cultivation, or the production of crops and livestock. It includes activities such as growing crops, raising animals for food or other products, and managing agricultural land for sustainable production.

**Non-agricultural purpose** refers to activities or uses that are not directly related to farming, cultivation, or the production of crops and livestock. It includes various uses of plant parts in areas such as medicine, construction, furniture, art, ceremonies, rituals, and education, as mentioned earlier. These uses are not primarily focused on agricultural production but rather on other aspects of human life and society.

**Plant parts that are used for both agricultural and non-agricultural purposes. Here are some examples:**

**1. Leaves:** Leaves are used in agriculture for photosynthesis, which is the process by which plants convert sunlight into energy. They are also used in non-agricultural settings for decoration, crafts, and as ingredients in herbal teas and medicines.

**2. Fruits**: Fruits are an important agricultural product and are consumed by humans and animals. They are also used in non-agricultural settings for cooking, baking, and making juices, jams, and preserves.

**3. Seeds**: Seeds are used in agriculture for planting and growing new plants. They are also used in non-agricultural settings for food production, such as in baking and cooking, as well as for making oils, flours, and other products.

**4. Roots**: Roots are used in agriculture for anchoring plants in the soil and absorbing water and nutrients. Some root vegetables, such as carrots and potatoes, are also consumed by humans. In non-agricultural settings, roots are used in traditional medicine and herbal remedies.

**5. Stems**: Stems provide support to plants and transport water, nutrients, and sugars throughout the plant. In agriculture, stems are used for propagation, such as in grafting and cloning. In non-agricultural settings, stems are used for crafts, construction, and making fibers for textiles.

**6. Flowers**: Flowers are important in agriculture for pollination and seed production. They are also used in non-agricultural settings for decoration, perfumes, and as ingredients in herbal teas and medicines.

***B9.5.5.1.2 Demonstrate the use of different plant parts for agricultural and non-agricultural purposes***

**Some common uses of plant parts for non-agricultural purposes:**

**1. Herbal medicines**: Various plant parts, such as leaves, roots, and flowers, are used in traditional and modern medicine to treat various ailments and promote overall health.

**2. Construction of houses, bridges, and furniture:** Wood from trees is commonly used in construction to build houses, bridges, and furniture. Different types of wood have different properties and are used for specific purposes based on their strength and durability.

**3. Artifacts:** Plant parts like leaves, stems, and flowers are often used in the creation of artifacts, such as decorative items, sculptures, and handicrafts.

**4. Ceremonies and rituals:** Plants play a significant role in ceremonies and rituals across different cultures. They are used for decorations, offerings, and symbolic purposes.

**5. Education:** Plant parts are used in educational settings to teach students about plant anatomy, biology, and ecology. They can be used for hands-on activities, experiments, and as visual aids. The uses of plant parts for agricultural purposes:

**Some common uses of plant parts for agricultural purposes**

1. **Planting:** Plant parts like seeds, bulbs, and cuttings are used to grow crops and cultivate new plants.

**2. Herbal Medicine**: Certain plant parts, such as leaves, flowers, roots, and bark, are used in herbal medicine for their medicinal properties.

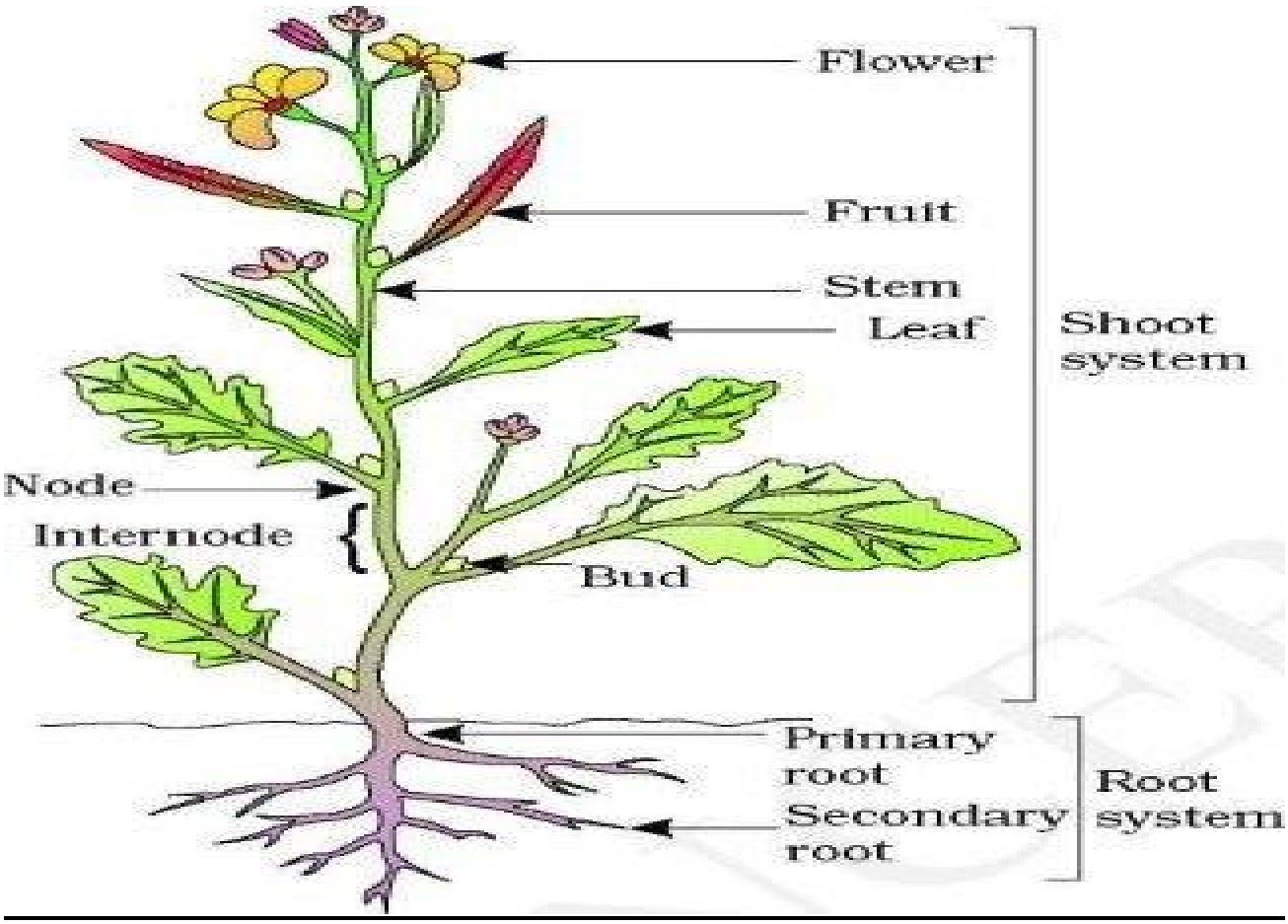
**3. Animal Housing:** Plants like grass, hay, and straw are used as bedding material for animals in agricultural settings.

**4. Construction of Houses**: Wood from trees is commonly used in the construction of agricultural buildings and structures.

**5. Animal Feed:** Plants like grass, grains, and silage are grown and used as feed for livestock and other farm animals.

**6. Soil Improvement:** Cover crops, green manure, and certain plant residues are used to improve soil fertility, structure, and nutrient content in agriculture.

**7. Pest and Diseases Control:** Some plants, like neem and garlic, have natural properties that can help control pests and diseases in agricultural settings.




**Benefits of using plant parts for agricultural purposes:**

1. Seeds provide new plants.
2. Fruits are nutritious and delicious.
3. Leaves can be used for food or medicine.
4. Roots anchor plants and absorb water and nutrients.
5. Stems support the plant and transport water and nutrients.

**Benefits of plant parts used for non-agricultural purposes**:

1. Leaves provide shade and help us stay cool.
2. Flowers make our surroundings beautiful and attract bees and butterflies.
3. Tree trunks can be used to make furniture and houses.
4. Roots help plants stay anchored in the ground and absorb water.
5. Fruits and seeds can be eaten by animals and humans as food.
6. Bark can be used to make paper and some medicines.
7. Stems provide support for plants to grow tall and straight.